

# Servicing Instructions

## For

# Hewland LD200 4 and 5 Speed Gearboxes

Hewland Engineering Limited

Waltham Road

White Waltham

Maidenhead

Berkshire

SL6 3LR

United Kingdom

Tel: +44(0)1628 827600

Fax: + 44(0)1628 829706

e-mail: [enquiries@hewland-engineering.co.uk](mailto:enquiries@hewland-engineering.co.uk)



**HEWLAND**  
ENGINEERING LIMITED

Note:

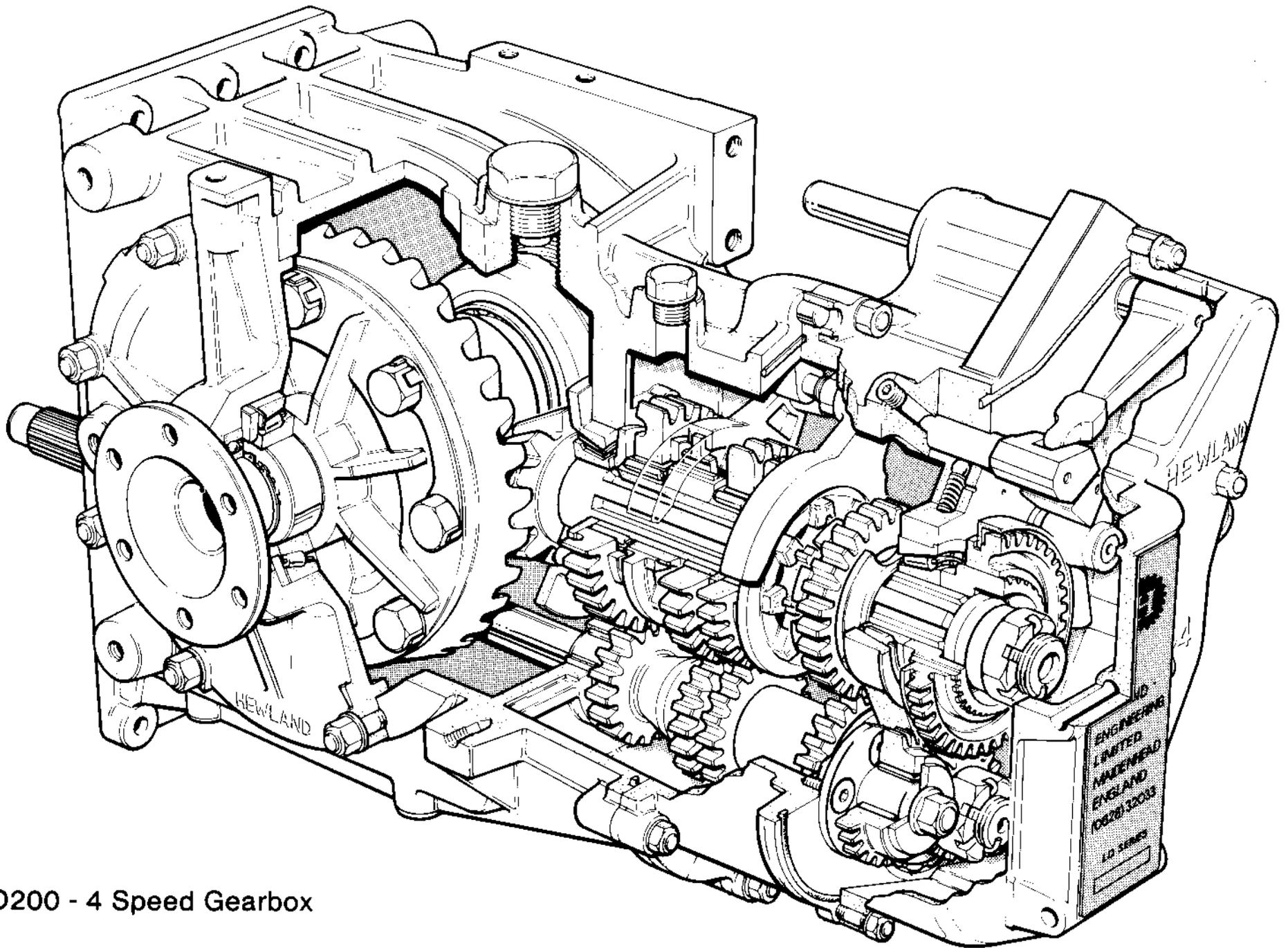
Illustrated Parts List (Parts Locator),  
Installation Drawings,  
Ratio Lists, Charts and Calculation Program

Can all be found on our web site:

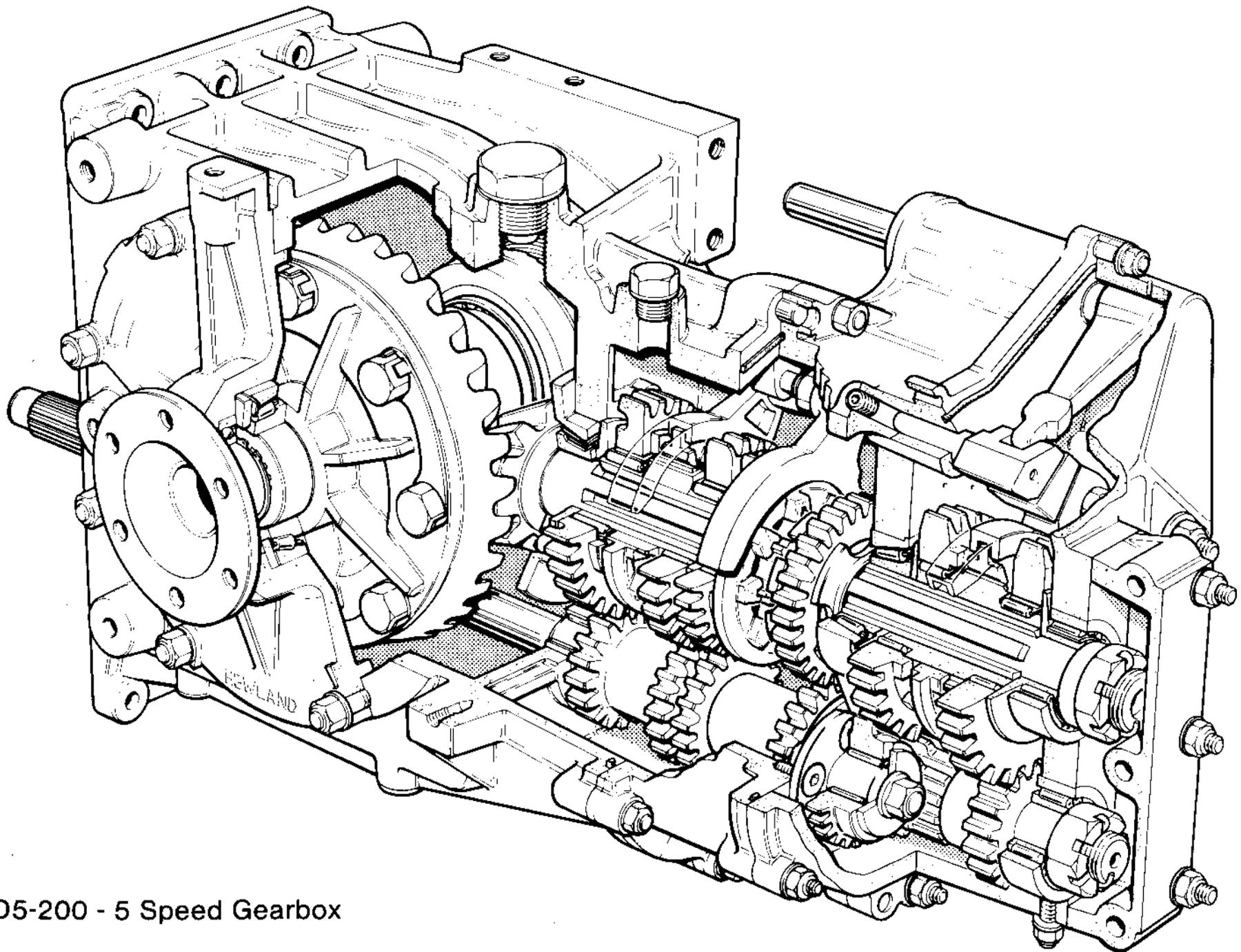
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LD200 - 4 Speed Gearbox



LD5-200 - 5 Speed Gearbox

## TECHNICAL SPECIFICATION

The LD 200 is designed for rear engined single seat competition cars of up to 165lbs.ft torque, exemplified by Formula Ford. The unit is produced with either four or five forward gears, and reverse. A free differential is standard, but power flow or cam & pawl limited slip differentials can be fitted if required.

The drive is taken from the engine via the clutch shaft, which turns input and pinion gears to drive the final transmission assembly.

Gear changing is effected through non-synchronised face dogs. An extensive range of gear ratios provides an unrestricted range of gearing requirements. Ratios can easily be changed whilst the unit is in the chassis.

The main case has one integral side plate, which imparts greater stiffness and rigidity to the gearbox.

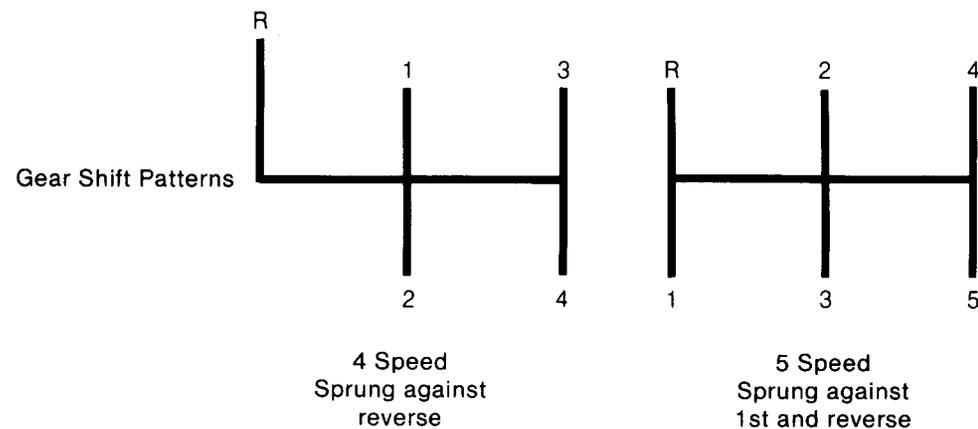
The differential and crownwheel assembly is mounted on two taper roller bearings located in the side plate and main case, and is adjusted to the correct pre-load and backlash by means of shims. The output shafts are mounted in the sideplates and are retained by circlips.

The pinion shaft is supported by two taper roller bearings, one in the main case and one in the bearing carrier. In the 5 speed box there is also a second bearing carrier, with an additional bearing on each shaft.

Heat treated nickel chrome steel is used for all gears and shafts. The selector forks are steel forgings. Lubrication is by splash, and the oil is retained by lipped oil seals. In general configuration, the LD is a high-tech racing transaxle unit which achieves the maximum effective use of power, in conjunction with light weight, for the power it is required to transmit.

	4 SPEED	5 SPEED
<b>Weight:</b>	66lbs.dry (29.9 kg) 68lbs.wet (30.8 kg)	72lbs.dry (32.66 kg)
<b>Oil type:</b>	SAE 80 or 90	As 4 Speed
<b>Oil quantity:</b>	1.75 pints (1 litre)	
<b>Max. torque recommended:</b>	165lbs.ft (22.1 mkg)	As 4 Speed
<b>CW &amp; pinion ratios:</b>	7:31, 8:31, 9:31, 10:31 & 13:36	9:31 & 10:31
<b>Gear ratios:</b>	From 2.923:1 to 1:1	As 4 Speed
<b>CW &amp; pinion backlash:</b>	0.005" minimum	As 4 Speed
<b>Pinion shaft pre-load:</b>	zero	As 4 Speed
<b>Oil level:</b>	See Page 5 (h)	As 4 Speed
<b>Torque Settings:</b>		
<b>Pinion nut:</b>	115lbs.ft (15.9 mkg)	As 4 Speed
<b>Layshaft nut:</b>	115lbs.ft (15.9 mkg)	As 4 Speed
<b>Crownwheel bolts:</b>	75lbs.ft (10.4 mkg)	As 4 Speed

Drive shaft pattern to VW (3.070" PCD) (78mm).  
Clutch shaft made to customers requirements.  
Selector finger diameter made to fit standard 5/8" Hookes joint.



## GENERAL NOTES

- a) Read these instructions carefully and with reference to the illustrations.
- b) Before dismantling the gearbox see that a clean tray is available in which to place the parts.
- c) Thoroughly clean and inspect all parts before reassembly. Discard any worn or damaged components and replace with new ones.
- d) Use only genuine Hewland spares as replacements. These are manufactured in our workshops to the fine tolerances necessary and are rigorously inspected.
- e) Always use new nuts, circlips, oil seals and gaskets when re-assembling.
- f) Bearing replacement:

Bearings can only be removed or renewed if the castings have been warmed in an oven, or with a blow lamp. In the latter case, keep the blow lamp moving while heating the castings.

N.B: DO NOT OVERHEAT. Test with a spot of water which will bounce off at the correct temperature.

Once a casting is heated, all bearings, outer tracks, oil seals and reverse idler spigots etc. which need to be fitted to it should be pushed into their respective seatings without delay, thus obviating any need for further re-heating. At the correct temperature fitting these items should present no difficulty.

When the castings have cooled down, it is advisable to place them once more under the press, as a matter of course, and apply light pressure to the bearings etc. to ensure that they are fully "home" and are seated squarely, before carrying out any settings or adjustments.

- g) Retaining screws:

There are two types of bearing retaining screw used on LD boxes, both of which have a short plain spigot section at the end, which locates in a recess on the O.D. of the bearing.

When fitting these bearings (see "f" above) it is important to see that the recess lines up accurately with the hole for the retaining screw, which can then be fitted when the casting has cooled down. The procedure for fitting retaining screws differs, depending on the type of screw. The "grub screw" type should be screwed in very gently until it is felt to just touch the bottom of the recess in the bearing. Turn the screw back about ¼ turn, which will withdraw it approximately 0.010" (0.25mm).

Making sure that the screw is held in this position, fit the washer & nut and tighten the nut, which will lock the screw in place. In the case of the "cap head" type fitted to the pinion tail bearing on the five speed box, fit a washer (FT 202-7) to it and wind the screw in finger tight until it can be felt to bottom in the recess. Measure the gap between the washer and the underside of the screw head and add another 0.010" (0.25mm) to this figure. Take the screw out again and remove this amount from the end of the spigot. (This ensures that the screw does not "bottom out" against the bearing and create distortion). Fit the retaining screw & washer, and tighten. After retaining screws have been fitted, it is well worth checking that the inner tracks can still be fitted into their respective bearings, and that they rotate freely.

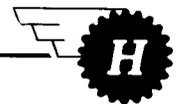
- h) Oil:

Always fill or top up the oil through the plug hole on top of the gear change section of the main case, with the gearbox/vehicle level. The oil will find its own level, with a proportion flowing through into the 'diff' compartment. When the oil has settled, its surface should be ¼" (6.3mm) below the bottom of the plug hole on the right hand side of the gearbox. This is the same for both 4-speed and 5-speed gearboxes, and the level can easily be checked with a piece of thin metal rod, bent at right angles and inserted through the plug hole.

NOTE: The large plug hole on top of the 'diff' housing is primarily for inspection purposes and should not be used for filling or topping up the oil. To do so would create a false reading of the level, as most of the oil would be trapped in the 'diff' compartment.

(Too much oil will not cause any harm however, but is nevertheless undesirable, as it may induce some power loss and overheating of the gearbox).

- j) A 1/16" dia. breather hole is provided in the top of the end cover (4 speed) or the second bearing carrier (5 speed).
- k) Where a procedure concerning either gearbox is only described briefly, it may be found useful to cross-refer to the appropriate sections(s) dealing with the other box, for more detailed information.



# POWERFLOW DIFFERENTIAL

## POWERFLOW DIFFERENTIALS - DETAILS AND SET UP. LD212.

These differentials ('diffs') are designed with versatility as their major asset. Many factors will contribute to the setting required. A car with good grip and low power may require a completely different arrangement to that of a high power/low grip example.

The principle; 10 slipping plates within the 'diff' (6 connected to the side gears/4 to the 'diff' casing) control the amount of differential action possible. So the amount of 'slip limiting' is dependent on one factor alone:

### FRICITION RESISTANCE OF THE TEN PLATES.

4 factors contribute to this: see diagram.

- 1) The bevel gears thrust apart as soon as the car moves. This is a feature of bevel gears and is not adjustable.
- 2) The ramp angle on the side gear ring has an effect on how much of the force driving the 'diff' round is directed sideways and on to the plates. For example, on the power/drive side ramp, 45 degrees transmits less force sideways than 30 degrees. Likewise on the brake/coast side ramp, an 80 degree angle will transmit little or no force whereas 45 degrees will transmit force. Check to see which different side gear rings are available for each model of 'diff'. 45/45 or 45/80 are normally fitted as standard.
- 3) The second adjustable factor for friction between the plates is simple; how tightly they are assembled to start with; or 'preload'.  
In each 'diff' there is a preload spacer. This looks like one of the 'B' plates, but thicker. It is the first component assembled into the 'diff' casing. The thickness of this dictates to what degree the plates are preloaded/forced against each other. This is set and checked on each 'diff' by holding one side gear still and turning the other with a torque wrench. A kit of bench service tools for this is available, with explanatory diagrams (part no. SK 846). If the measured resistance is deemed too high, the spacer is ground down until the desired figure is achieved. (Usually between 5 to 20 ft/lbs). The figure should be checked periodically as it tends to reduce as the 'diff' runs in. A new, slightly thicker spacer will allow resetting.
- 4) The final and easiest adjustment is the re-arrangement of the contact order of the plates. (See diagram). Arranged as shown; A to B to A to B to A. This has the maximum amount of friction faces working, and is the way in which they are arranged as standard. If they are arranged so as not to have an A touching a B as frequently, then the torque figure measuring the resistance; as in 3); will reduce. e.g: The minimum amount of faces working is B to B to A to A to A. To swap from maximum to minimum in this way tends to approximately halve the torque figure. Always ensure that the plate arrangements on both the right and left hand sides of the 'diff' correspond.

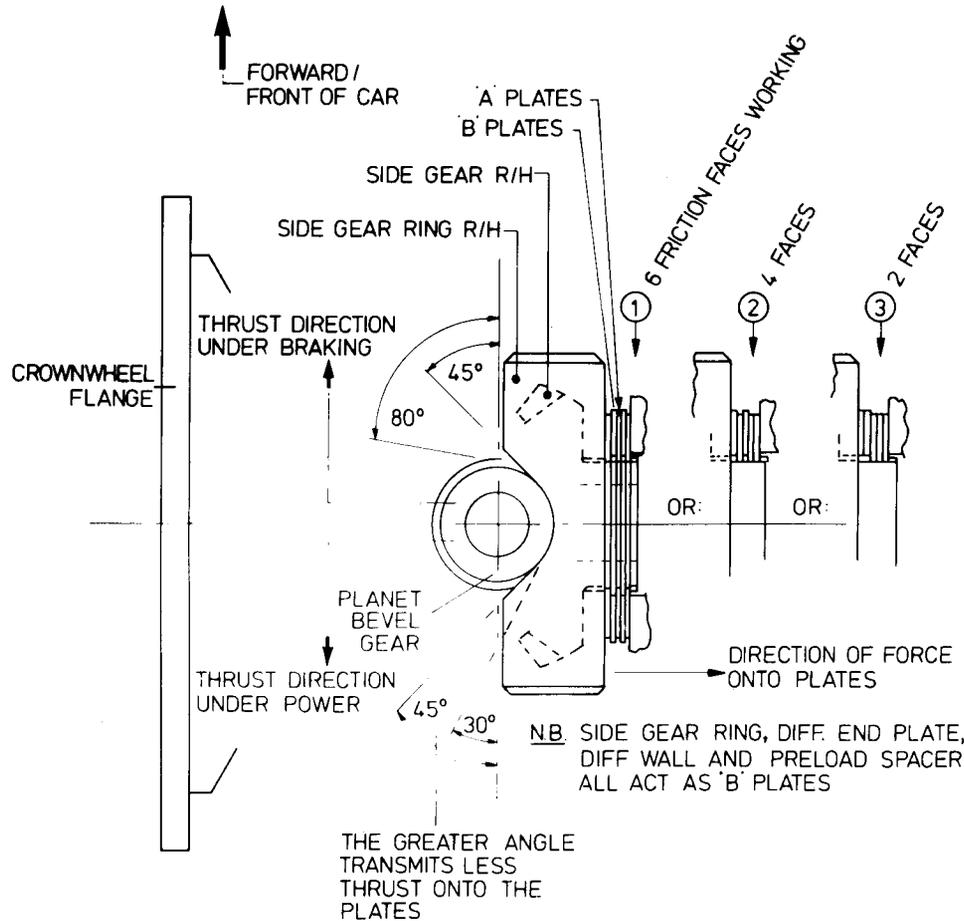


Fig. 1

## DIFFERENTIAL BEARING PRE-LOAD - 4 & 5 SPEED

- a) Assemble the differential unit and fit crownwheel to it.
- b) With pinion shaft and 1st bearing carrier assembled and correctly set up in accordance with Pinion Pre-load (page 11), fit the differential unit and sideplate to the main-case, using solid dummy bearings (SK 119-Mk 9) in place of the two taper roller bearings.
- c) Turn the pinion shaft by hand to test the pre-load. Adjust by means of sideplate shims (HC 9-206-1) until satisfactory.  
NB. Using reasonable effort, it should be possible to turn the pinion shaft by hand by gripping the rear hub. Bear in mind that greater effort will be needed with dummy bearings than with real ones. It is essential to retain some backlash during this operation. Absence of backlash will create a false impression of pre-load.

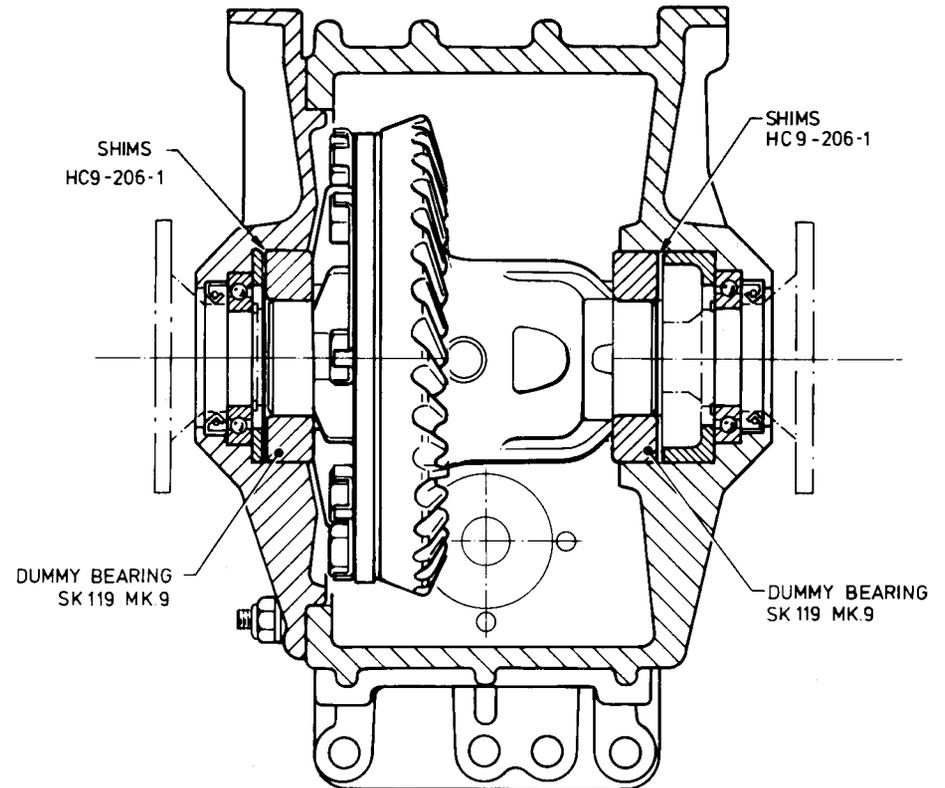


Fig. 2



## PINION SETTING - 5 SPEED

Special Hewland part required: Pinion Setting Jig SK 681

a) Attach the 1st bearing carrier (LD 5-202) to the main case and assemble the bearings and pinion shaft, together with spacer (LD 5-229-5), 1st/rev hub (LD 227), inner track (F3A 229) and nut (FT 230) as shown. Tighten the nut until the bearings are just fully seated and all end play is eliminated.

b) Fit pinion setting jig and check the clearance at point "Y". This clearance should comply with the dimension stamped on the face of the pinion head. The gap can be adjusted by means of the addition or removal of shims (LD 222-2) as necessary at point "X" until the correct clearance is obtained.

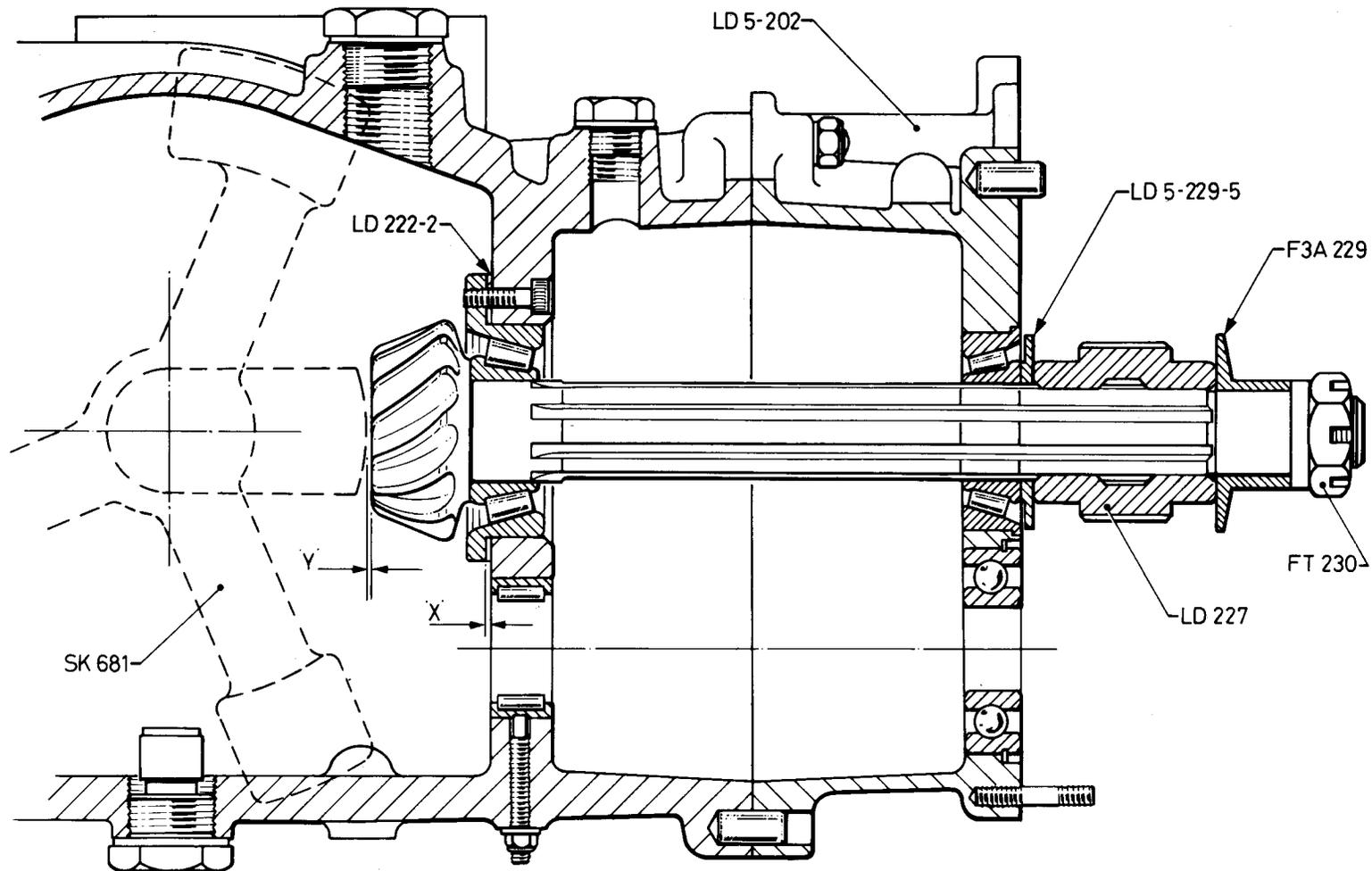


Fig. 4



## CROWNWHEEL & PINION BACKLASH SETTING - 4 & 5 SPEED

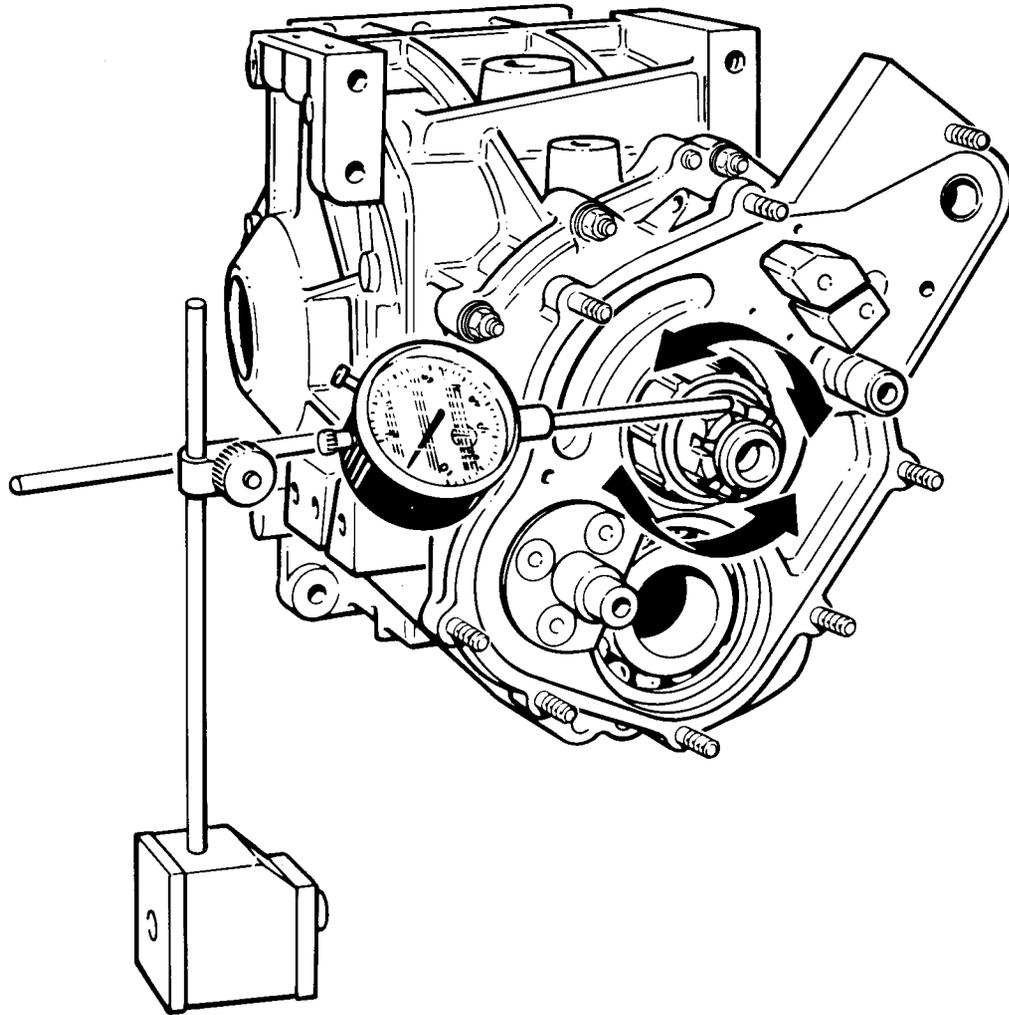


Fig. 5

a) When the correct pre-load has been obtained, as described previously (page 7), the actual amount of backlash can be ascertained by means of a dial test indicator against the rear hub or tail nut. Take at least 20 readings, rotating the crownwheel 15-20 degrees between each reading. (This is to ensure that any variations due to manufacturing tolerances, or heat treatment, are taken into account). Using this method, the minimum measured backlash at any point should not be less than 0.005" (0.127mm).

If backlash is found to be incorrect, the condition is rectified by removing shims (HC9-206-1) from one side and inserting them in the opposite side, as appropriate. Do not discard or add any shims at this stage, as to do so would affect the pre-load.

NOTE: Dummy bearings (SK 119-Mk 9) should be retained in the sideplates to facilitate shim changing.

Before new bearing outer tracks are subsequently shrunk into the sideplates, the width of each must be measured and compared with the relevant dummy bearing. Any difference must be compensated for in final shimming.

b) Refer to General Notes, part "f" for method of fitting bearings and seals.

c) Press bearings (HC 9-205-1) on to the differential; press in drive shafts (LD 218) and fit circlips (FT 219-1A).

## PINION PRE-LOAD 4 & 5 SPEED

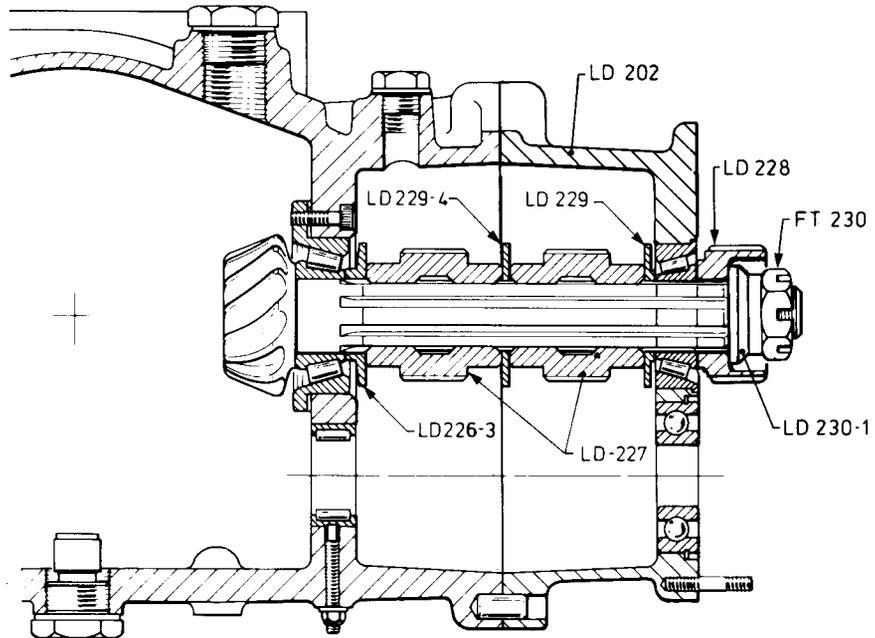


Fig. 6

a) Assemble pinion shaft into the bearings with the hubs and spacers as shown in Fig. 6 (4 speed) or Fig. 7 (5 speed).

b) Measure the end float.

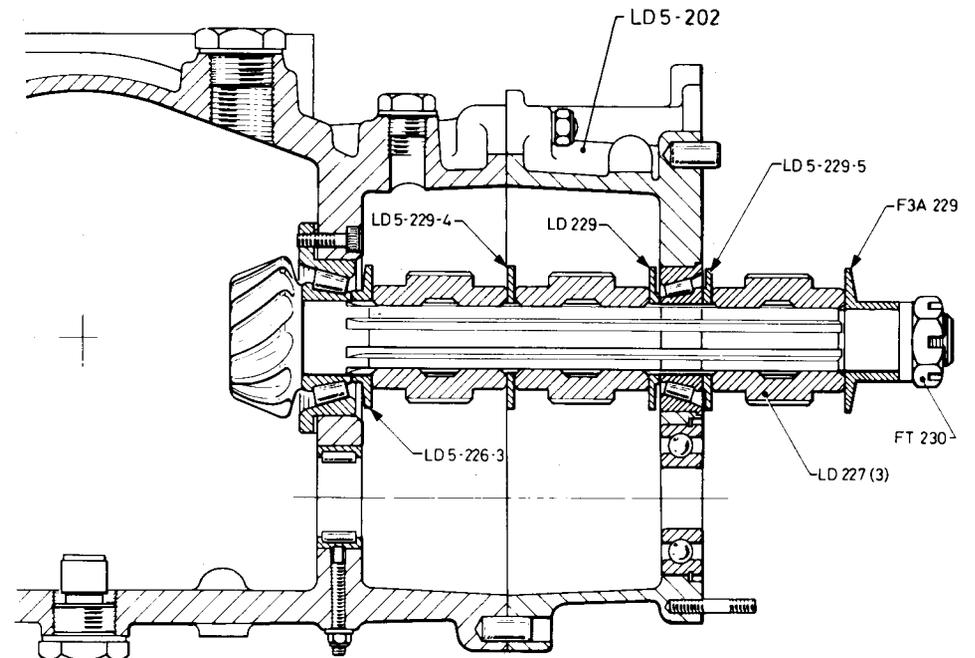


Fig. 7

c) Calculate for zero pre-load as follows:-  
Thickness of LD 229 less the measured end float.

d) The faces of LD 229 must be ground evenly to the thickness calculated at "c".



## SELECTOR ROD SETTING & LINE UP - 4 SPEED

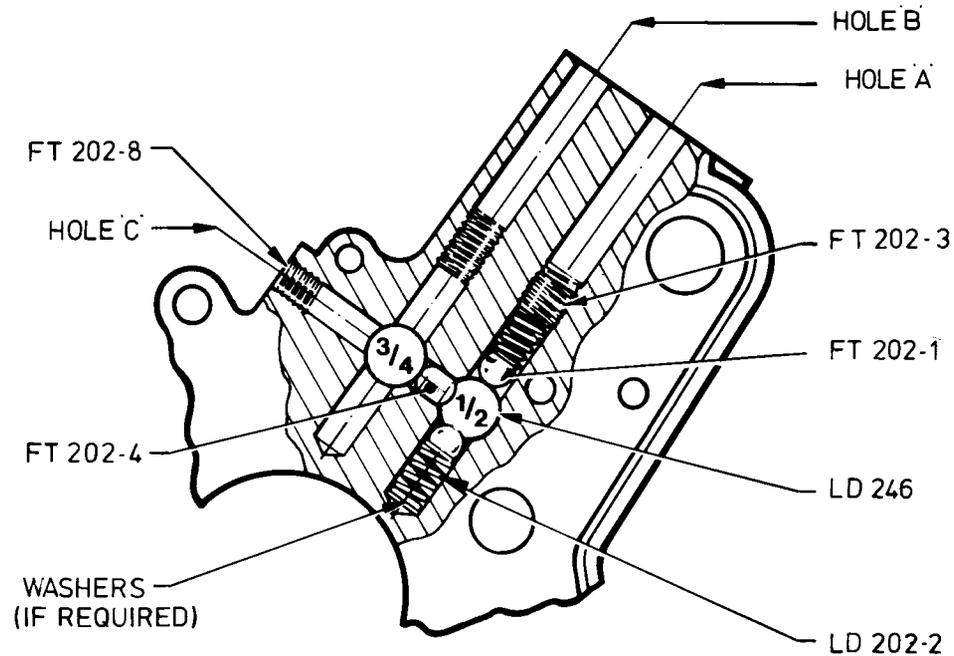


Fig. 8

- Drop a spring (LD 202-2) and a ball (FT 202-1) into hole "A". The ball should be seen to protrude into the selector rod hole by about 0.10" (2.5mm). If required, this can be adjusted by either grinding the spring, or by inserting one or more washers beneath the spring, as shown.
- Introduce the end of the 1st/2nd selector rod (LD 246) into its hole and slide the rod forward, pressing the ball down, if necessary, to allow the rod to proceed until the ball is felt to locate into the neutral detent. The upper ball & spring can now be dropped into position, and the plug (FT 202-3) screwed in, with a drop of Loctite on the thread until the desired pre-load is achieved. In each case the upper spring controls the "in-gear" detent and can be adjusted for pressure by means of the plug (FT 202-3), screwing it farther in to hold in gear harder, or withdrawing it for softer retention.  
NOTE: Once in gear the design of the dogs ensures that the clutch ring is held in position, irrespective of spring pressure.
- Before fitting the 3rd/4th selector rod, the interlock plunger (FT 202-4) must be inserted. To do this, lean the bearing carrier to the right until hole "C" is vertical. The plunger is then dropped into hole "C".
- Return the bearing carrier to the upright position and repeat steps "a" & "b" above for the 3rd/4th selector rod (LD 247), taking care to ensure that the interlock plunger is still correctly positioned between the two selector rods.
- Check that the selector finger slots line up in the neutral position, and that the selector rods move smoothly between both engaged positions and neutral.
- Screw plug (FT 202-8) into hole "C" with a drop of Loctite on the thread.

## SELECTOR ROD SETTING & LINE UP - 5 SPEED

- a) Tilt the bearing carrier to the left until holes "A", "B" & "C" are vertical.
- b) Fit the 2nd/3rd selector rod (LD 5-246) in the centre hole, following the method as in parts "a" & "b", page 12.
- c) Tilt the bearing carrier further over until hole "E" is vertical, and drop in the interlock plunger (FT 202-4).
- d) Tilt the bearing carrier back so that holes "A", "B" & "C" are again vertical and repeat step "b" for the 1st/rev selector rod (LD 5-248), fitting it into the right hand hole.  
NB. It is essential that the 1st/rev selector rod is fitted so that the flats on the collar of the rod are parallel with the lower interlock plunger hole "E", and that the positioning line on the collar is facing in the direction of the arrow, as shown in Fig. 9 (If the rod is assembled wrongly, i.e. 180 degrees out, with the positioning mark facing towards the centre selector rod, the centre rod will become locked in neutral, making it impossible to select 2nd or 3rd gears).
- e) Next, tilt the bearing carrier over to the right until hole "D" is vertical, drop in the interlock plunger, and tilt back again to the left just enough for the ball & spring to slide into place in hole "B", but not enough for the interlock plunger to become dislodged. Then fit the 4th/5th selector rod (LD 5-247) etc., following the procedure already described.
- f) Ascertain that both interlock plungers are still in place between adjacent selector rods and check that each rod will move smoothly between both engaged positions and neutral.
- g) Fit the 1st/rev selector fork (LD 5-251) and spacer (LD 5-248-4), taking care not to rotate the selector rod when tightening the nut.
- h) With all selector rods in the neutral position, check that the selector finger slots are in line. If necessary, grind the faces of the 1st/rev selector rod spacer (LD 5-248-4) to achieve accurate alignment.
- j) Fit plugs (FT 202-8) to holes "E" & "D" with a drop of Loctite on the thread.

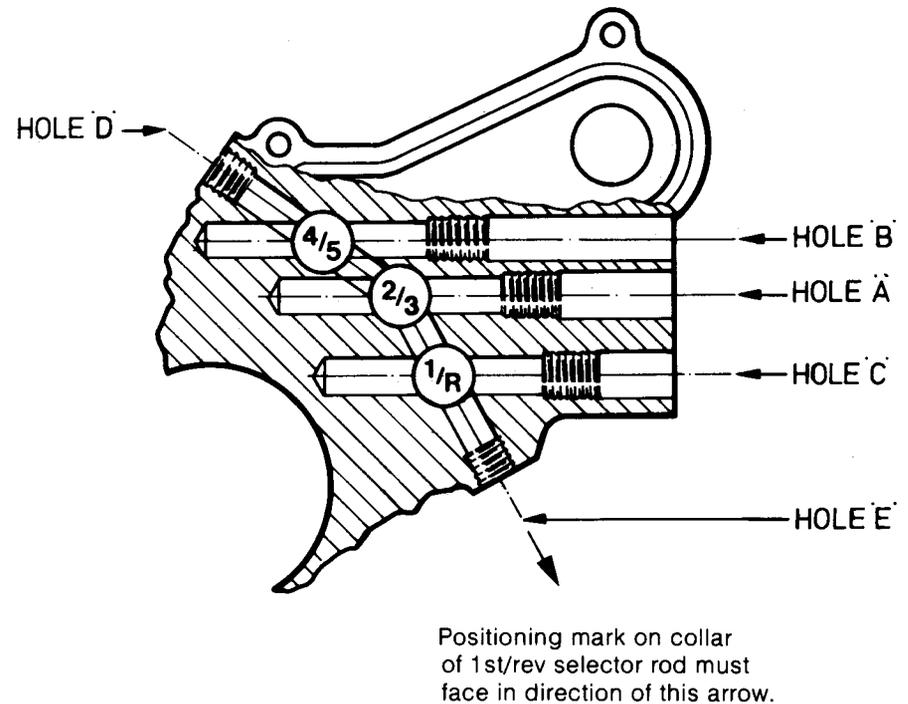


Fig. 9



## FORK SETTING - 4 SPEED - USING EARLY TYPE TOOLING - SK704

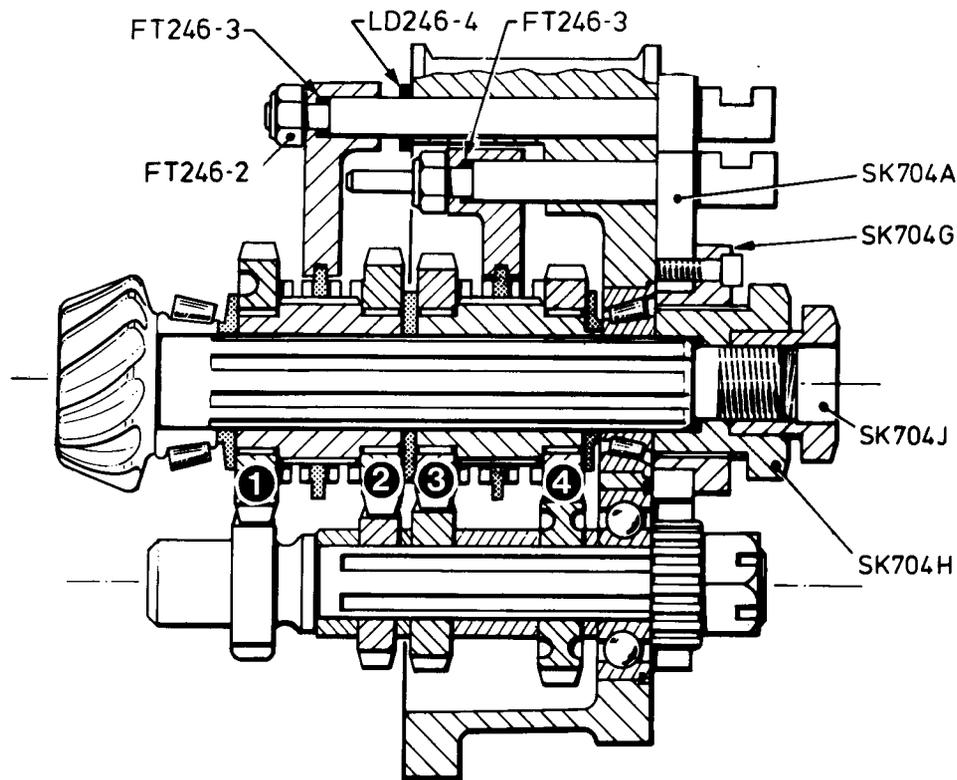


Fig. 10

**NOTE: There are two types of fork setting & assembly fixtures; the earlier type (SK 704) can only be used with 4-speed gearboxes, whereas the later type (SK 810) can be used for either 4-speed or 5-speed fork setting & assembly operations.**

This section refers to the earlier type of tooling, suitable for LD 4-speed gearboxes only.

Special Hewland tools required:-

1. Plate SK 704A
2. Flanged ring SK 704G
3. Screwed sleeve SK 704H
4. Special nut SK 704J

- a) Assemble plate (SK 704A), flanged ring (SK 704G) and screwed sleeve (SK 704H) as shown. With bearings in place fit plate assembly to rear face of bearing carrier and hold in a vice.
- b) Fit pinion assembly into the bearing carrier as shown. (There is no need to fit the layshaft assembly at this stage).
- c) Adjust screwed sleeve (SK 704H) until all slack in pinion shaft rear bearing has been eliminated. Hold screwed sleeve to prevent rotation and tighten layshaft special nut (SK 704J).
- d) Fit 3rd/4th gear selector fork, and grind the relevant selector rod spacer (FT 246-3), as necessary, to comply with the conditions set out on page 17, part "j".
- e) Fit 1st/2nd gear selector fork and adjust selector rod spacers as in previous step.  
Note that the stop/spacer (LD 246-4) may also require adjustment, in order to achieve correct setting of the fork.
- f) Next, fit new nuts (FT 246-2) to both selector rods, and tighten to secure the forks. Check that the selector rod heads are correctly aligned, and that there is about 0.005" (0.127mm) clearance between them.
- g) Finally, fit the complete layshaft assembly and check that the meshing gears line up correctly, and that there is no fouling of any components, either with each other or with the bearing carrier casting. If line-up adjustment is necessary, grind the layshaft spacers, as required, to rectify.

**NOTE: The reverse fork is checked for correct functioning after final assembly with the maincase. (see page 19, parts "g" & "k"). No provision is made for adjustment, which should not be necessary.**

## FORK SETTING - 4 SPEED - USING LATER TYPE TOOLING - SK810

The following concerns use of the dual purpose jig assembly (SK810) which is suitable for both 4-speed and 5-speed LD gearboxes.

For list of tooling components see page 17.

- a) Attach the 4 pillars (SK 810C) and bridge plate (SK 810A) to the rear of the bearing carrier, and hold in a vice by gripping the bridge plate (not the bearing carrier).
- b) Check that the inner race of the taper roller bearings (LD 229-1 B) is in place, and feed the dummy shaft (SK810B) through the bearing from the front, and as it proceeds, fit onto it the sleeve (SK810J) and retaining washer (SK810E) and secure it with nut (SK810G), tightening it by hand until the retaining washer just nips against the shoulder of the dummy shaft.
- c) Lightly grease the point of the knurled centre screw (SK810D) and wind it in until it engages in the centre at the end of the dummy shaft. Continue winding in until resistance is felt, and the taper roller bearing is seen to be correctly located. (Check that end play in the dummy shaft has been eliminated, but that it can still be rotated by hand).
- d) Assemble the middle and front hubs & spacers, together with needle races, gears & clutch rings onto the dummy shaft; fit spacer ring (SK 810F) & nut (SK 810H) and tighten sufficiently to eliminate all end play in the stack-up of hubs & spacers.
- e) Fit 3rd/4th gear selector fork, spacer and nut.
- f) Check that the knurled centre screw has not slackened off, and proceed with fork adjustment, which must satisfy the conditions described on page 17, part "j".

(If fork adjustment is found to be needed, it is achieved by grinding the appropriate selector rod spacer (FT 246-3) to the required thickness).

- g) Fit 1st/2nd gear selector fork, spacers and nut, and adjust as in previous step. Note that the stop/spacer (LD 246-4) may also require grinding.
  - h) Next, fit new nuts (FT 246-2) to both selector rods, and tighten to secure the forks. Check the selector rod heads for alignment. (See page 14, part "f").
  - i) Finally, fit the complete layshaft assembly and verify that the meshing gears line up correctly and that there is no fouling of any components, either with each other or with the bearing carrier casting.
- If line-up adjustment is needed, grind the appropriate layshaft spacer(s), as necessary, to rectify.

NOTE: The reverse fork is checked for correct functioning after final assembly with the maincase. (see page 19, parts "g" & "k"). No adjustment of the reverse fork setting should be needed and is therefore not provided for.

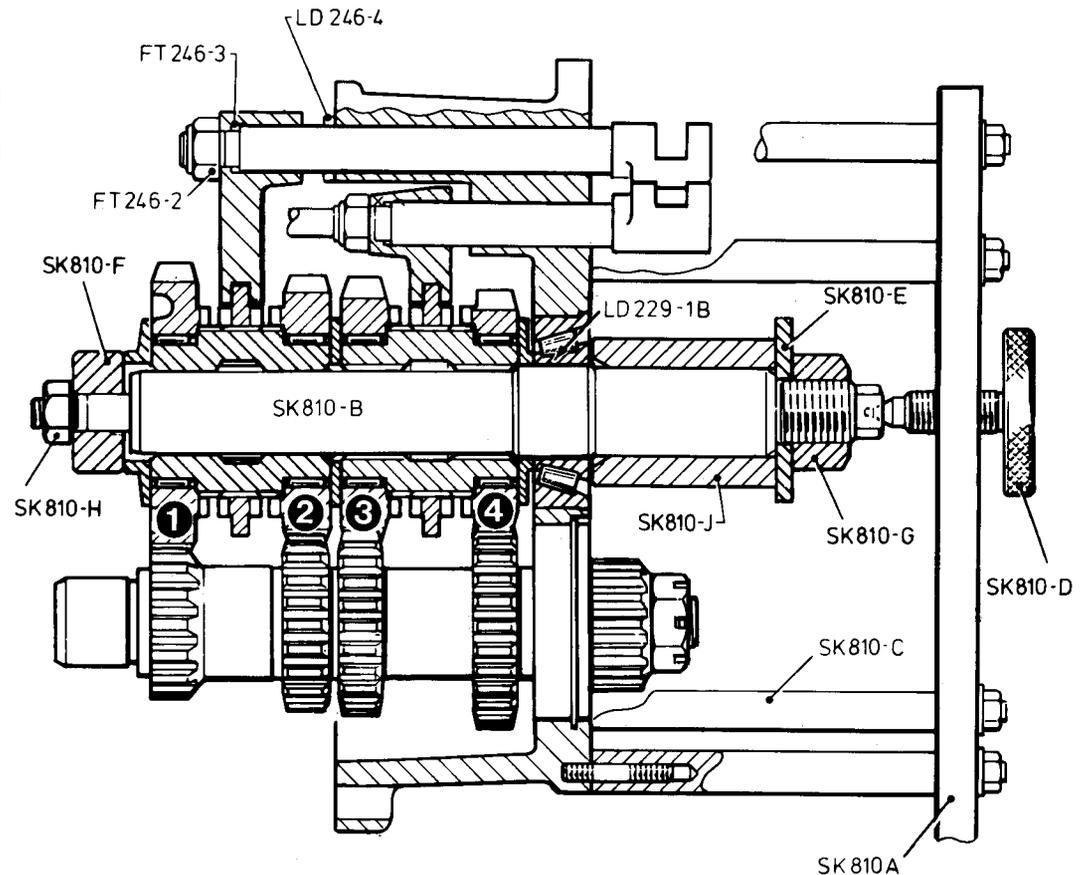


Fig. 11



# FORK SETTING - 5 SPEED

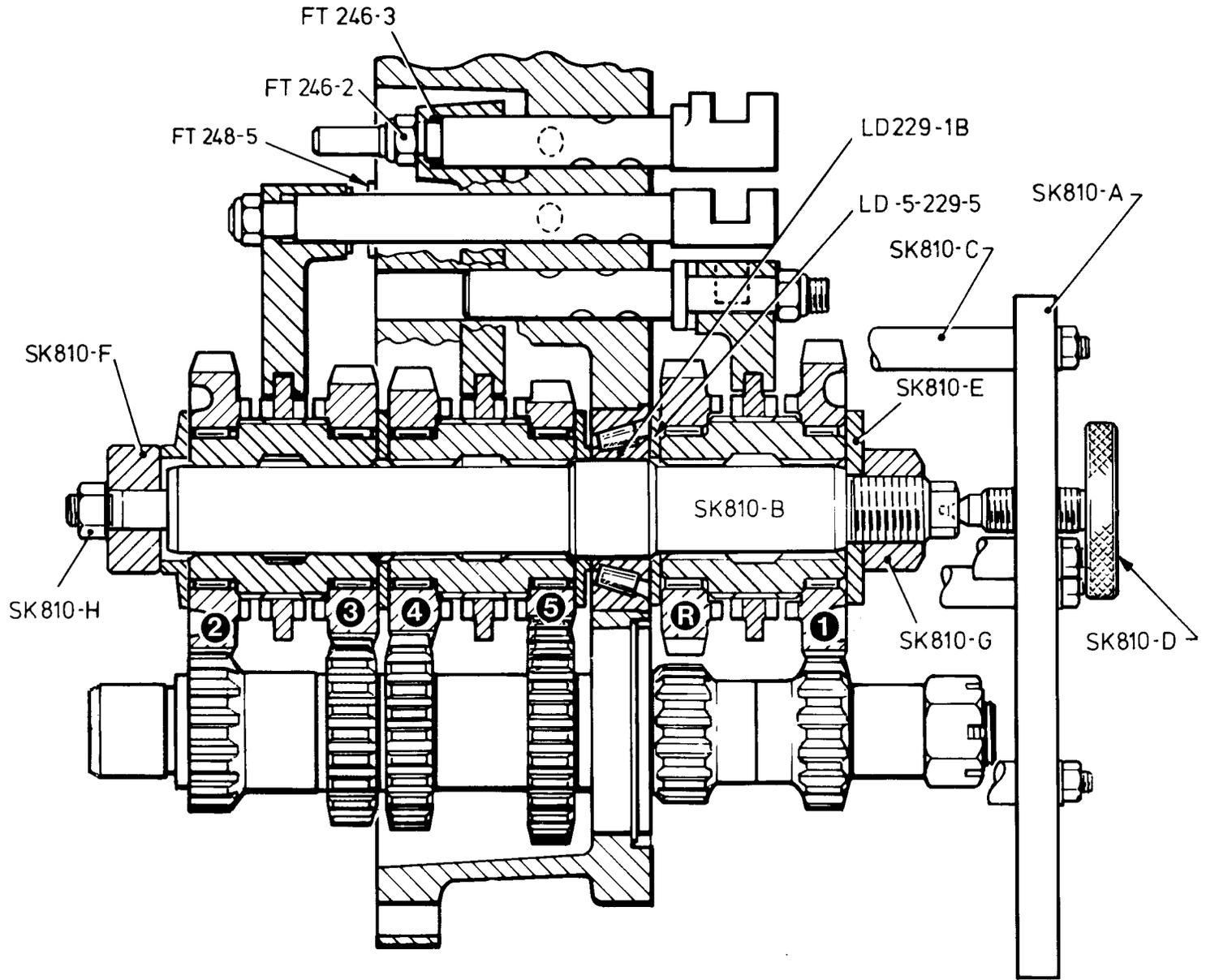


Fig. 12

## FORK SETTING - 5 SPEED

For this operation we recommend the use of a Hewland fork setting jig assembly (SK 810). This is also designed for fork setting & assembly operations on LD 4-speed gear boxes and comprises the following components:-

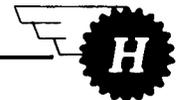
1. Bridge plate SK 810A
2. Dummy shaft SK 810B
3. Pillars (4) SK 810C
4. Knurled centre screw SK 810D
5. Retaining washer SK 810E
6. Spacer ring SK 810F
7.  $\frac{3}{4}$ " UNF nut SK 810G
8.  $\frac{3}{8}$ " UNF nut SK 810H
9. Sleeve SK 810J (4-speed only)

- a) Remove the bearing carrier from the maincase and the hubs and spacers from the pinion shaft. Allow the pinion shaft to hang loosely in the maincase.
- b) Attach the four pillars (SK 810C) and the bridge plate (SK 810A) to the rear of the bearing carrier, and hold in a vice by gripping the bridge plate (not the bearing carrier).
- c) Move the 1st/rev selector fork into the 1st gear position and check that the inner race of the taper roller bearing (LD 229-1 B) is in place.
- d) Assemble the 1st/rev hub, clutch ring, needle races and gears and offer up into place, engaging the clutch ring in the fork.
- e) While holding the hub assembly in position, together with spacer (LD 5-229-5) feed the dummy shaft (SK 810B) through the bearing, spacer and hub assembly from the front until the large diameter on the dummy shaft has located in the bearing bore.
- f) Fit the retaining washer (SK 810E) and nut (SK 810G) to the dummy shaft and tighten the nut by hand until the retaining washer just nips against the shoulder of the dummy shaft.
- g) Lightly grease the point of the knurled centre screw (SK 810D) and wind it in until it engages in the centre at the end of the dummy shaft. Continue winding in until resistance is felt, and the taper roller bearing, spacer and 1st/rev hub are all seen to be correctly located. (Check that slack in the dummy shaft has been eliminated, but that it can still be rotated by hand).

- h) At this stage it is desirable to carry out 1st/rev setting, although it can be left until after step "n", if preferred.

1st/rev setting is accomplished by first of all checking that the slots for the selector finger have been lined up correctly, as in Page 13, part "h", and then setting the hub assembly in relation to the fork. This is achieved by grinding the spacer (LD 5-229-5) as necessary to obtain the conditions described below, in part "j" (See Fig. 12).

- j) Correct positioning requires that:-
  - i) In the neutral position the clutch ring should be central on its hub between the two gears.
  - ii) Each clutch ring should engage with the dogs on either gear when the selector rod is moved into an engaged position.  
Also, when in gear the selector fork should not rub on either side of the clutch ring.
  - iii) In the engaged position there should still be 0.005" clearance between the gear and clutch ring faces. This will ensure that the selector fork does not force the clutch ring hard up against the gear, which could cause excessive friction and wear on the fork.
- k) Assemble the middle and front hubs & spacers, together with needle races, gears & clutch rings, on the dummy shaft; (take care not to confuse the spacers, which must be installed in their correct positions - see N.B. on page 21) fit spacer ring (SK 810F), and nut (SK 810H), and tighten sufficiently to eliminate all end play in the stack-up of hubs and spacers.
- l) Fit 4th/5th selector fork, spacer and nut.
- m) Check that the knurled centre screw has not slackened off, and proceed with fork adjustment (4th/5th). This is achieved by grinding the selector rod spacer (FT 246-3) to a thickness which will position the fork so as to satisfy the requirements of part "j".
- n) Repeat steps "l" & "m" for the 2nd/3rd selector fork; note that the stop/spacer (FT 248-5) may also require adjustment to obtain correct setting.
- o) Next, tighten all three selector rods using new nuts (FT 246-2), again taking care to see that the 1st/rev selector rod does not rotate at all while the nut is being tightened. At the same time, re-check that the selector rod heads are correctly aligned, and that there is about 0.005" (0.127mm) clearance between them.
- p) Finally, fit the complete layshaft assembly, and verify that the meshing gears line up accurately and that there is no fouling of any components, either with each other or with the bearing carrier casting. If line-up adjustment is necessary, grind the appropriate layshaft spacer(s), as required to rectify.



# ASSEMBLY - 4 SPEED

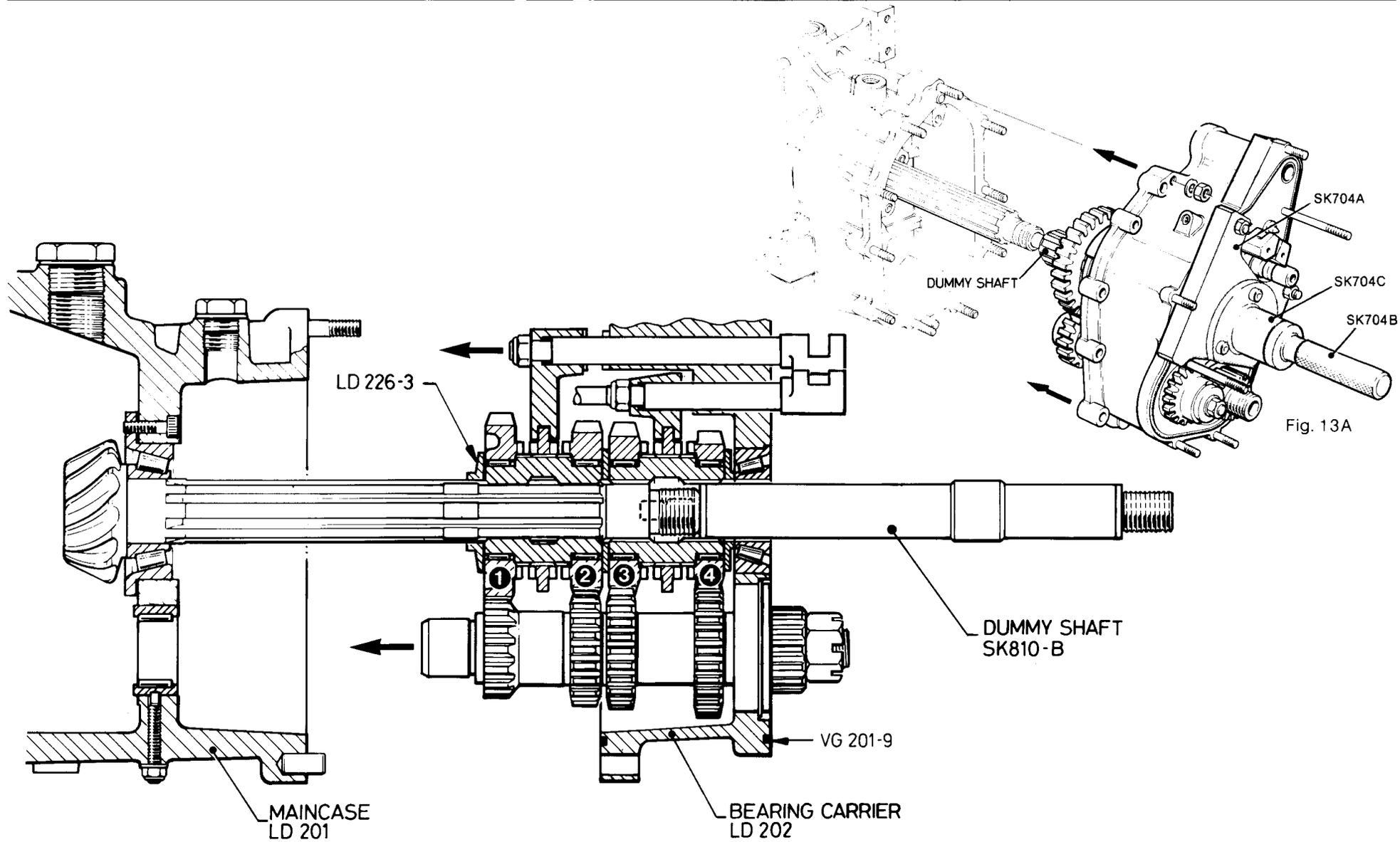


Fig. 13

## ASSEMBLY - 4 SPEED

LD 4-speed gearboxes can be assembled using either the earlier type of dummy shaft or the later type, which is also used for 5-speed gearboxes. The procedure is the same in both cases.

Special Hewland parts required:

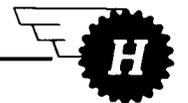
EITHER: Dummy shaft SK704 B - early type tooling (with or without plate & sleeve).

OR: Dummy shaft SK810 B - later type.

- a) It is assumed that the layshaft assembly is already fitted to the bearing carrier.
- b) Insert the dummy shaft from the rear of the bearing carrier and assemble the pinion shaft components on to it, locating the clutch rings into their respective selector forks. Take care not to confuse the front and rear spacers (LD 226-3) & LD 229). (LD 226-3 is the thicker one, and must be fitted next to the pinion head bearing, as shown in Fig. 13).
- c) Engage 4th gear and insert the spigot of the dummy shaft into the end of the pinion shaft in the gearbox maincase.
- d) Carefully slide the complete assembly from the dummy shaft and on to the pinion shaft. It may be necessary to rotate the individual components slightly to facilitate alignment of the splines.
- e) As the assembly slides towards the rear of the maincase, enter the layshaft end into its bearing, and feed the bearing carrier onto the maincase studs and dowels. Ensure that the "D" section seal (VG 201-9) is in position and not fouled.
- f) The dummy shaft can now be removed from the bearing carrier, together with the plate and sleeve, if used.
- g) Secure the bearing carrier with two nuts, and fit the reverse hub (LD 228), spacer (LD 230-1), nut (FT 230), sliding gear (HC 8-4-231) and the reverse selector arm (LD 253), complete with its ball (FT 203-3), spring (FGA 6-203-4) and set screw (FT 202-8).
- h) Once the gear cluster is assembled and the bearing carrier is in position, engage both reverse and first gears together; this will lock the shafts and must be done in order to fit & tighten the two large nuts. The upper shaft is the pinion shaft, and has a LH thread. The lower is the layshaft and this has a RH thread.

- i) Lightly tighten pinion shaft & layshaft nuts and then torque both nuts to 115lbs.ft (15.9mkg). If the split pin holes do not line up, increase the torque to align them.
- k) At this stage it is advisable to check that all the gears can be selected, by moving the selector rods back and forth, in and out of all five gears. Fit the remaining eight M8 Nyloc nuts & washers, and secure the bearing carrier.
- l) Fit the selector finger and align the end cover over the bearing carrier studs. Check that the "D" section seal is in position within its groove, and secure the end cover with nine M6 Nyloc nuts & washers.
- m) Top up with the correct grade of new oil to the prescribed level. (See Technical Specification and General Notes, 'h'). When the correct level is attained, replace all plugs. Re-connect the gear change linkage to the chassis.

NOTE: When fully conversant with the gearbox, it may be found easier/quicker to dispense with the use of a dummy shaft during this operation. The gear cluster is assembled in the same manner as that described, but without the dummy shaft, and must be supported by hand when feeding onto the pinion shaft.



# ASSEMBLY - 5 SPEED

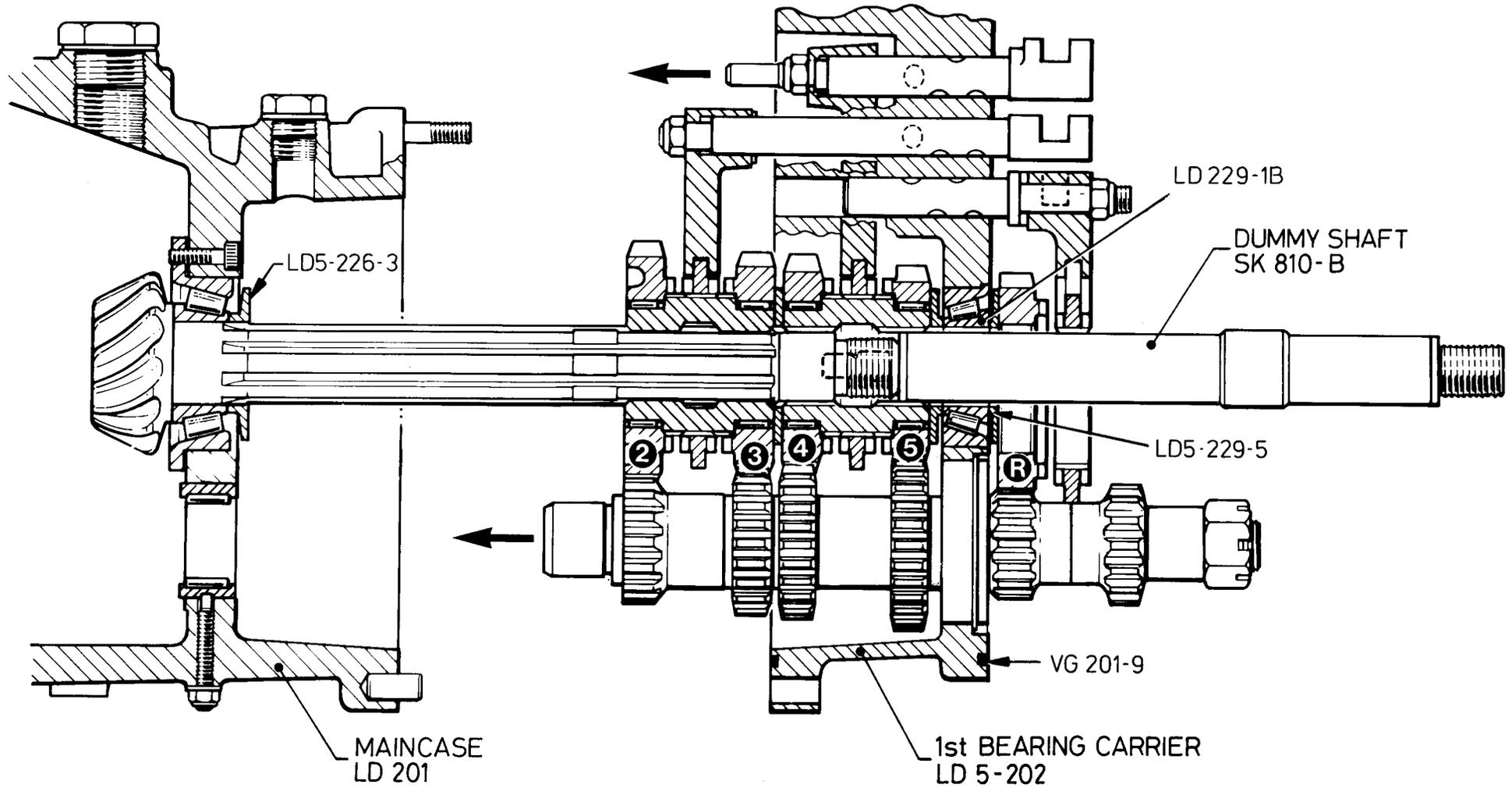


Fig. 14

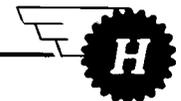
- a) Assuming that fork setting (pages 16 and 17) has been carried out, and that the layshaft assembly has been fitted to the bearing carrier, remove the assembly from the vice and take off the bridge plate and pillars.
- b) Remove the nut, washer and spacer ring from the front end of the dummy shaft, and the nut & retaining washer from the rear end.
- c) Carefully pull off the rear hub, together with needle races and first gear, allowing the clutch ring and reverse gear to rest on the dummy shaft.  
NOTE: If preferred, the 1st/rev fork may be temporarily removed, together with the whole 1st/rev hub assembly.
- d) Engage 5th gear, and carefully offer up the whole bearing carrier and gear assembly towards the rear of the maincase, entering the spigot of the dummy shaft into the rear end of the pinion shaft as far as it will go.
- e) By gently sliding the assembly forward and maintaining the pinion shaft in position, the hubs & spacers will be transferred onto the pinion shaft, while the dummy shaft emerges from the rear. (It may be necessary to rotate the shafts and gears slightly during this operation in order to facilitate alignment of the splines).  
As the assembly moves forward, enter the layshaft end into its bearing, ensuring that the clutch shaft (if fitted) engages properly in the layshaft end, and feed the bearing carrier onto the maincase studs & dowels. At this point it may be necessary to tap the bearing carrier gently with a soft faced hammer until it is fully 'home'.
- f) Remove the dummy shaft from the rear. Fit nuts & washers, and secure the bearing carrier to the maincase.  
Refit the rear hub assembly to the pinion shaft, together with the inner track (F3A-229), ensuring that the inner race (LD 229-1B) and spacer (LD 5-229-5) are properly located.
- g) Pull out the 1st/rev selector rod to engage first gear, in addition to the fifth gear which is already engaged, thus locking the shafts. Fit the selector finger and engage it with the 4th/5th selector rod head. Remove the layshaft tail nut (if already fitted). Place the second bearing carrier (LD 5-203) in position, making sure that the "D" section seal is seated correctly in the rear face of the 1st bearing carrier; fit nuts & washers, and tighten. Fit tail nuts to the pinion shaft and layshaft, torque up to 115lbs.ft (15.9mkg) in both cases, and fit split pins (FT 230-1).
- h) Remove the 1st gear stop screw (LD 5-248-5), insert a suitable rod through the hole thereby exposed, and GENTLY press the 1st/rev selector rod head until it clicks back into the neutral position. Take care not to push it beyond neutral!! Return the 4th/5th selector rod to neutral in the normal way and check that the selector finger moves freely through the "gate".

- i) Refit the 1st gear stop screw, setting it so that it just touches the end of the 1st/rev selector rod when 1st gear is engaged, and tighten the locknut.
- k) Top up with the correct grade of oil, to the specified level (see page 5 'h').
- l) Fit the clutch shaft assembly, as shown in Fig. 21 (if not already in place).  
NOTE: When carrying out ratio changes in the field (see page 23) the bridge plate & pillars would not be used; any reference to them in the foregoing assembly procedure should therefore be ignored.

**N.B. It is most important that the four spacers on the pinion shaft are fitted in their correct positions, and the right way round.**

The thickest spacer is fitted first, immediately behind the pinion head bearing. The plain one goes on next, between the front and centre hubs, and the other shouldered spacer, which also has a scalloped O.D., is fitted between the centre hub and the centre (tapered) bearing. The "adjustment" spacer is positioned behind this bearing, in front of the rear hub, with its shouldered side toward the bearing. This spacer is clearly identified by a flat milled on the O.D..

Refer to Figs. 14 & 18.



## CHANGING GEAR RATIOS - 4 SPEED

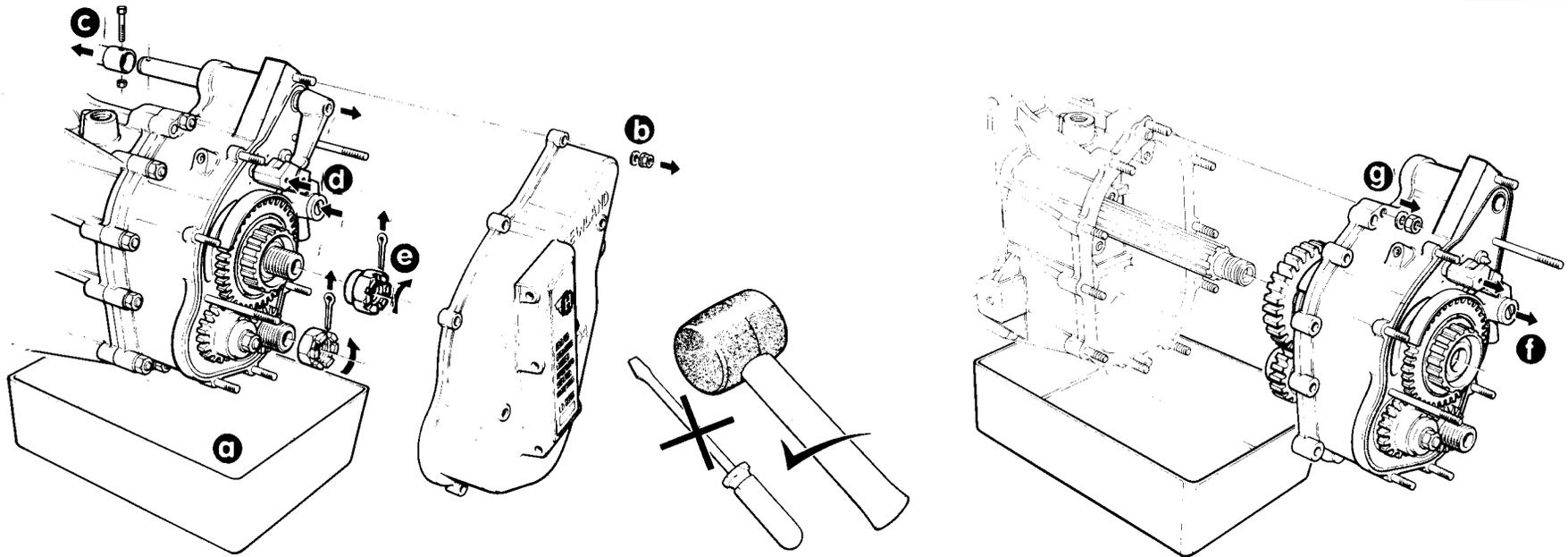


Fig. 15

- a) With a drip tray placed beneath the gearbox remove the drain plug and drain the oil.
- b) Remove the nine M6 nuts securing the gearbox end cover, and take it off.
- c) Disconnect the gear change linkage from the chassis to the gearbox and remove the selector finger.
- d) Push the top selector rod in to engage 1st gear, and the bottom one to engage reverse gear, thus locking the shafts.
- e) Withdraw the split pins from the pinion shaft and layshaft and remove both tail nuts, bearing in mind that the pinion shaft nut has a LH thread and has to be turned clockwise to undo.
- f) Return the gears to the neutral position by pulling out the selector rods which were previously pushed in at step "d".
- g) Remove the ten M8 nuts & washers securing the bearing carrier. The bearing carrier can now be withdrawn from the maincase; to break the seal it may be helpful to use a soft hammer for this purpose. Do not use a screwdriver as this may damage the joint surfaces and impair the seal efficiency when re-assembled.  
NOTE: The layshaft, with its associated gears and spacers will all slide away with the bearing carrier. The pinion shaft will remain in place within the maincase:

therefore when removing the bearing carrier it is necessary to support the gear cluster with one hand whilst sliding the assembly off the shaft. (At this point it is normal for the pinion shaft to be "floating").

- h) Replace gears with the required ratios.  
Gears are supplied in matched pairs, one for the pinion shaft and one for the layshaft. Each gear is etched or stamped with two sets of numbers. The first of these indicates the number of teeth on the layshaft gear, while the second figure signifies the number of teeth on the pinion shaft gear which mates with it; both gears of each pair are marked in an identical manner. It is essential that gears are correctly paired to these numbers.  
Note that for some first gears the gear teeth are machined integral with the layshaft. In such cases, therefore, if a change to first gear ratio is required, the layshaft itself will have to be changed.
- i) Whilst changing ratios, it is advisable, as a matter of course, to wash and inspect all used components which are to be used again, before re-fitting; check for wear and cracks, particularly to the clutch rings. Also, examine the selector forks for heavy or uneven wear, ensuring that clearance between forks and clutch rings is not excessive. If forks are not to be removed, check that nuts (FT 246-2) are tight.
- k) Reassemble the gearbox - see page 19.

# CHANGING GEAR RATIOS - 5 SPEED

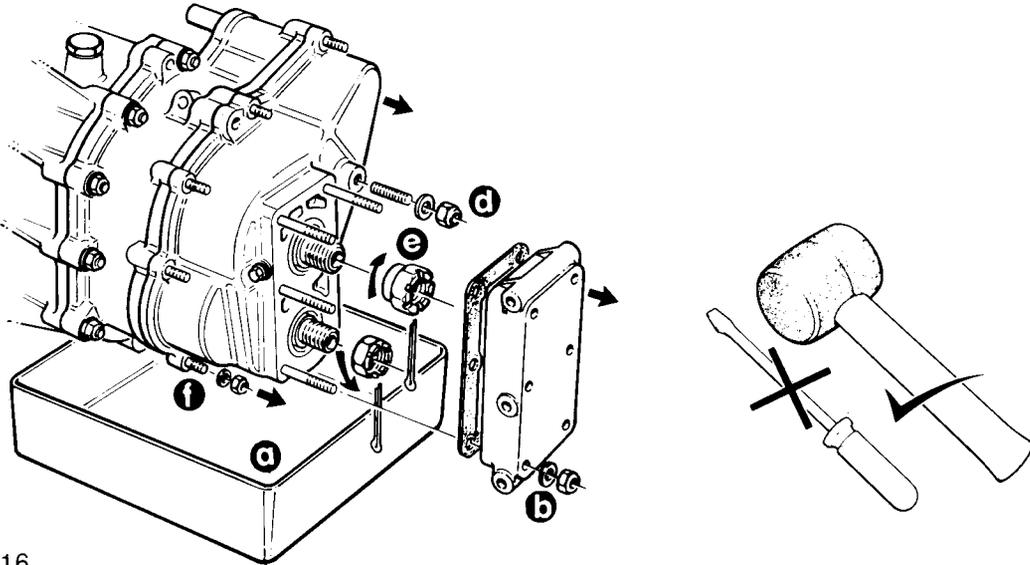
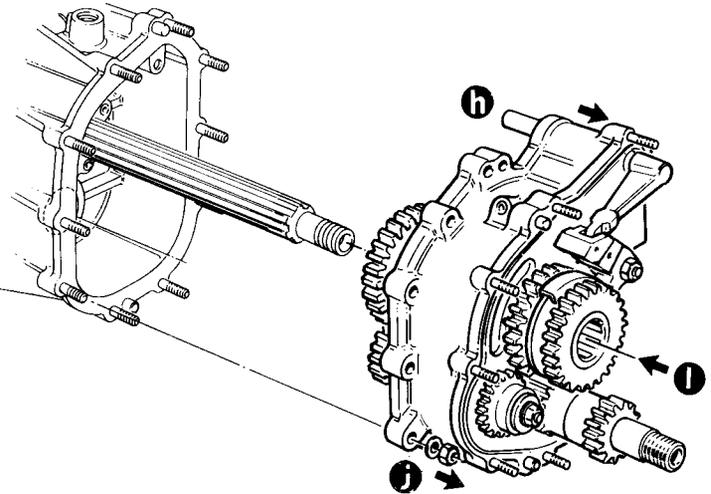


Fig. 16



- a) Remove the drain plug and drain the oil into a suitable receptacle placed beneath the gearbox.
- b) Remove the six M8 nuts & washers securing the end cover (LD 5-204) and take it off.
- c) Engage 4th or 5th gear.
- d) Remove the 1st gear stop screw (LD 5-248-5) together with its locknut & washer, and using a suitable rod or screwdriver through the hole thus exposed, push in the 1st/rev selector rod to engage reverse gear. (Both shafts should now be locked).
- e) Remove the split pins & nuts from the rear end of the pinion shaft and layshaft, remembering that the pinion shaft nut has a LH thread and will have to be turned clockwise to undo.
- f) Remove the nine M6 nuts & washers securing the 2nd bearing carrier (LD 5-203) and gently tap the "knock-off" lugs with a soft faced hammer until clear of the dowels. The 2nd bearing carrier can then be carefully removed.  
NOTE: If it is desired to change 1st gear ratio only, this can now be accomplished without any further dismantling.  
If any of the other forward gear ratios need to be changed continue as follows:-
- g) Remove the rear hub, etc. as in page 21, "c".

- h) Return the gears to the neutral position, and disconnect the gear linkage from the front end of the selector finger.
- i) Remove the ten M8 nuts & washers securing the 1st bearing carrier to the maincase, and ease it back off the dowels & studs, using a soft faced hammer, if necessary, to break the seal. Insert the spigot end of the dummy shaft (SK 810B) into the rear end of the pinion shaft and continue drawing the bearing carrier away from the maincase.  
NOTE: The layshaft, with its gears & spacers will all slide out as an assembly with the bearing carrier, while the pinion shaft hubs & spacers are transferred onto the dummy shaft. (Some "jiggling" of the dummy shaft, hubs & spacers will probably be necessary at this stage). The pinion shaft will remain "floating" loosely from the pinion head bearing.
- k) Change gears to the required ratios. (See page 22, parts "h" & "j").  
NOTE: If fork setting is required, it should be performed at this stage, before re-assembly.
- l) Re-assemble gearbox. (see page 21, part "d" onwards).  
NOTE: With practice, it may be found easier and quicker to dispense with the use of the dummy shaft during ratio changing and re-assembly, but in that case care must be taken to support the gear clusters & spacers by hand.



## CHANGING GEAR RATIOS - 5 SPEED

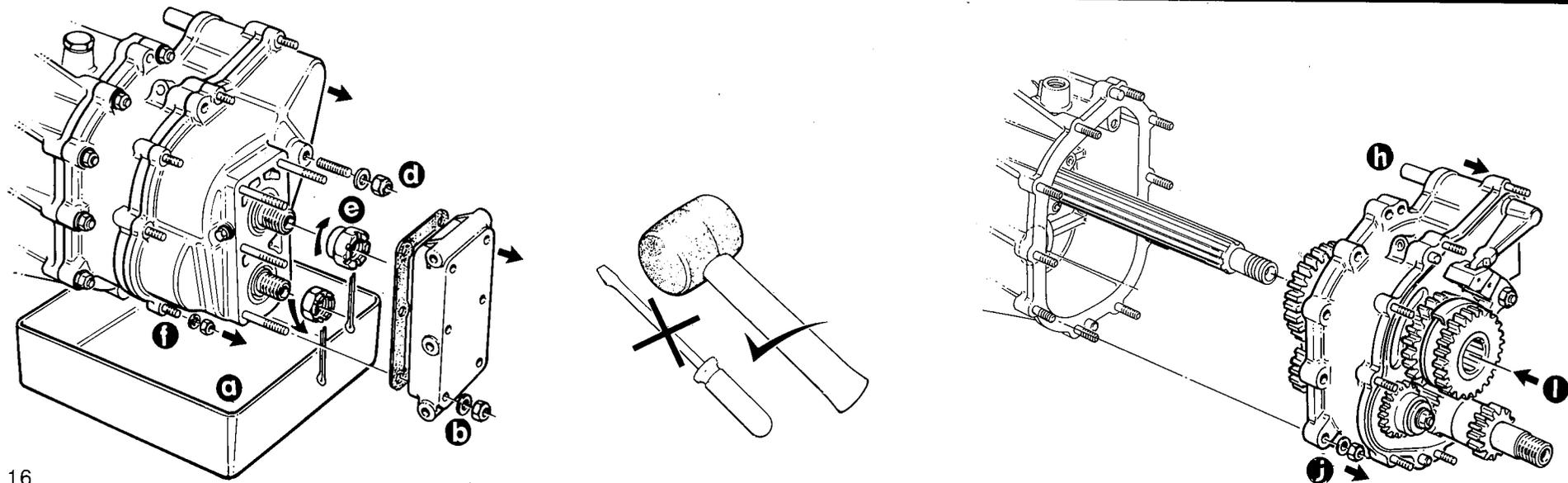
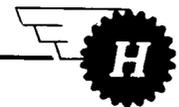


Fig. 16

- a) Remove the drain plug and drain the oil into a suitable receptacle placed beneath the gearbox.
- b) Remove the six M8 nuts & washers securing the end cover (LD 5-204) and take it off.
- c) Engage 4th or 5th gear.
- d) Remove the 1st gear stop screw (LD 5-248-5) together with its locknut & washer, and using a suitable rod or screwdriver through the hole thus exposed, push in the 1st/rev selector rod to engage reverse gear. (Both shafts should now be locked).
- e) Remove the split pins & nuts from the rear end of the pinion shaft and layshaft, remembering that the pinion shaft nut has a LH thread and will have to be turned clockwise to undo.
- f) Remove the nine M6 nuts & washers securing the 2nd bearing carrier (LD 5-203) and gently tap the "knock-off" lugs with a soft faced hammer until clear of the dowels. The 2nd bearing carrier can then be carefully removed.  
NOTE: If it is desired to change 1st gear ratio only, this can now be accomplished without any further dismantling.  
If any of the other forward gear ratios need to be changed continue as follows:-
- g) Remove the rear hub, etc. as in page 21, "c".
- h) Return the gears to the neutral position, and disconnect the gear linkage from the front end of the selector finger.
- i) Remove the ten M8 nuts & washers securing the 1st bearing carrier to the maincase, and ease it back off the dowels & studs, using a soft faced hammer, if necessary, to break the seal. Insert the spigot end of the dummy shaft (SK 810B) into the rear end of the pinion shaft and continue drawing the bearing carrier away from the maincase.  
NOTE: The layshaft, with its gears & spacers will all slide out as an assembly with the bearing carrier, while the pinion shaft hubs & spacers are transferred onto the dummy shaft. (Some "jiggling" of the dummy shaft, hubs & spacers will probably be necessary at this stage). The pinion shaft will remain "floating" loosely from the pinion head bearing.
- k) Change gears to the required ratios. (See page 22, parts "h" & "j").  
NOTE: If fork setting is required, it should be performed at this stage, before re-assembly.
- l) Re-assemble gearbox. (see page 21, part "d" onwards).  
NOTE: With practice, it may be found easier and quicker to dispense with the use of the dummy shaft during ratio changing and re-assembly, but in that case care must be taken to support the gear clusters & spacers by hand.



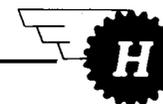
# GEAR RATIOS

Circuit				Date																														
	DRY	WET	QUAL				DRY	WET	QUAL				DRY	WET	QUAL				DRY	WET	QUAL				DRY	WET	QUAL							
1st							1st							1st							1st							1st						
2nd							2nd							2nd							2nd							2nd						
3rd							3rd							3rd							3rd							3rd						
4th							4th							4th							4th							4th						
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Comments:						Comments:						Comments:						Comments:																

Circuit				Date		Circuit				Date		Circuit				Date		Circuit				Date												
	DRY	WET	QUAL				DRY	WET	QUAL				DRY	WET	QUAL				DRY	WET	QUAL				DRY	WET	QUAL							
1st							1st							1st							1st							1st						
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**ILLUSTRATED PARTS LIST  
GEAR RATIO CHARTS  
INSTALLATION INFORMATION**



# GEAR TRAIN ASSEMBLY - 4 SPEED

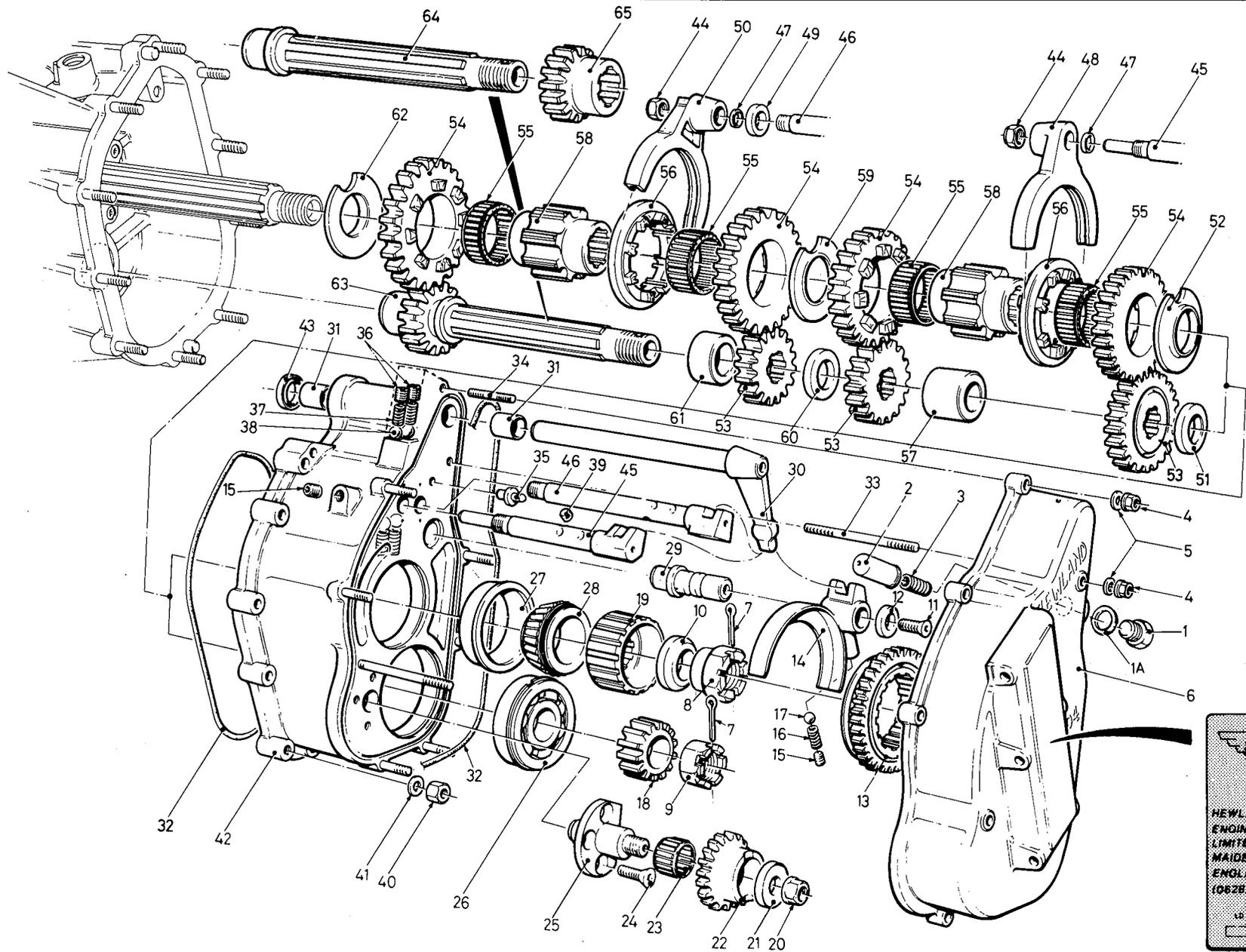


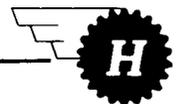
Fig. 17

## PARTS LIST - GEAR TRAIN ASSEMBLY 4 SPEED

Item No.	Description	Part No.	Qty.	Item No.	Description	Part No.	Qty.
1	Plug	FT 203 5	1	37	Spring Selector	LD 202 2	4
1A	Dowty Washer	LD 203 7	1	38	Ball - Selector	FT 202 1	4
2	Reverse Plunger	LD 203 0	1	39	Plunger Selector Rods	FT 202 4	1
3	Spring - Reverse Plunger	HC 9 203 2	1	40	Nut M8 Nyloc	HC 201 3A	10
4	Nut M6 Nyloc	LD 202 10	9	41	Washer 5/16in.	FT 202 7	10
5	Washer M6	LD 202 9	9	42	Bearing Carrier	LD 202	1
6	End Cover	LD 204	1	43	Oil Seal - Selector Finger	FT 2037 S	1
7	Split Pin	FT 230 1	2	44	Nut - Selector Rod	FT 246 2	2
8	Nut - Pinion Shaft (L.H. thread)	FT 230	1	45	Selector Rod 3rd/4th	LD 247	1
9	Nut - Layshaft	LD 236	1	46	Selector Rod 1st/2nd	LD 246	1
10	Spacer	LD 230 1	1	47	Spacer - Selector Rods	FT 246 3	2
11	Screw M6 Csk.	LD 253 4	1	48	Selector Fork 3rd/4th	LD 250	1
12	Stop Washer	LD 253 3	1	49	Stop Spacer	LD 246 4	1
13	Reverse Sliding Gear	HC 8 4 231	1	50	Selector Fork 1st/2nd	LD 249	1
14	Reverse Selector Arm	LD 253	1	51	Spacer Layshaft Tail	LD 234 5	1
15	Set Screw	FT 202 8	2	52	Spacer Pinion Tail	LD 229	1
16	Spring - Reverse Selector Arm	FGA 6 203 4	1	53	Input Gears	LD 235	3
17	Ball - Reverse Selector Arm	FT 203 3	1	54	Pinion Shaft Gears	LD 233	4
18	Reverse Input Gear	LD 238	1	55	Needle Bearing	LD 226 1	4
19	Reverse Hub	LD 228	1	56	Clutch Ring	LD 232	2
20	Nut - Reverse Idler	VG 237 5	1	57	Spacer 3rd/4th	LD 234 8	1
21	Washer - Reverse Idler	FT 237 4	1	58	Hub	LD 227	2
22	Gear - Reverse Idler	LD 237 1	1	59	Spacer - Hubs	LD 229 4	1
23	Bearing - Reverse Idler	LD 237 2	1	60	Spacer 2nd/3rd	LD 234 7	1
24	Screw M8 Csk.	F3 237 8	3	61 *	Spacer 2nd	LD 234 6	1
25	Spigot - Reverse Idler	LD 237 3	1	62	Spacer - Front - Pinion Shaft	LD 226 3	1
26	Bearing - Layshaft Tail (C/W Ring)	LD 234 3	1	63	Layshaft with Integral 1st Gear	LD 234	} 1
27	Pinion - Tail Bearing - Outer Track	LD 229 1A	1	64	Layshaft - (plain)	LD 234 A	
28	Pinion - Tail Bearing	LD 229 1B	1	65 **	Layshaft 1st Gear (used as 2nd on 5 speed)	LD 235 1	1
29	Reverse Selector Arm Shaft	LD 253 1	1				
30	Selector Finger	LD 252	1				
31	Bush - Selector Finger	FT 203 6	2				
32	Sealing Strip ('D' Section)	VG 201 9	A/R				
33	Stud - Long - Bearing Carrier	LD 202 6	2				
34	Stud - Short - Bearing Carrier	LD 202 5	7				
35	Guide Pin	LD 202 13	1				
36	Set Screw - Selector	FT 202 3	2				

\* Used with item 63.

\*\* Used with item 64.



# GEAR TRAIN ASSEMBLY - 5 SPEED

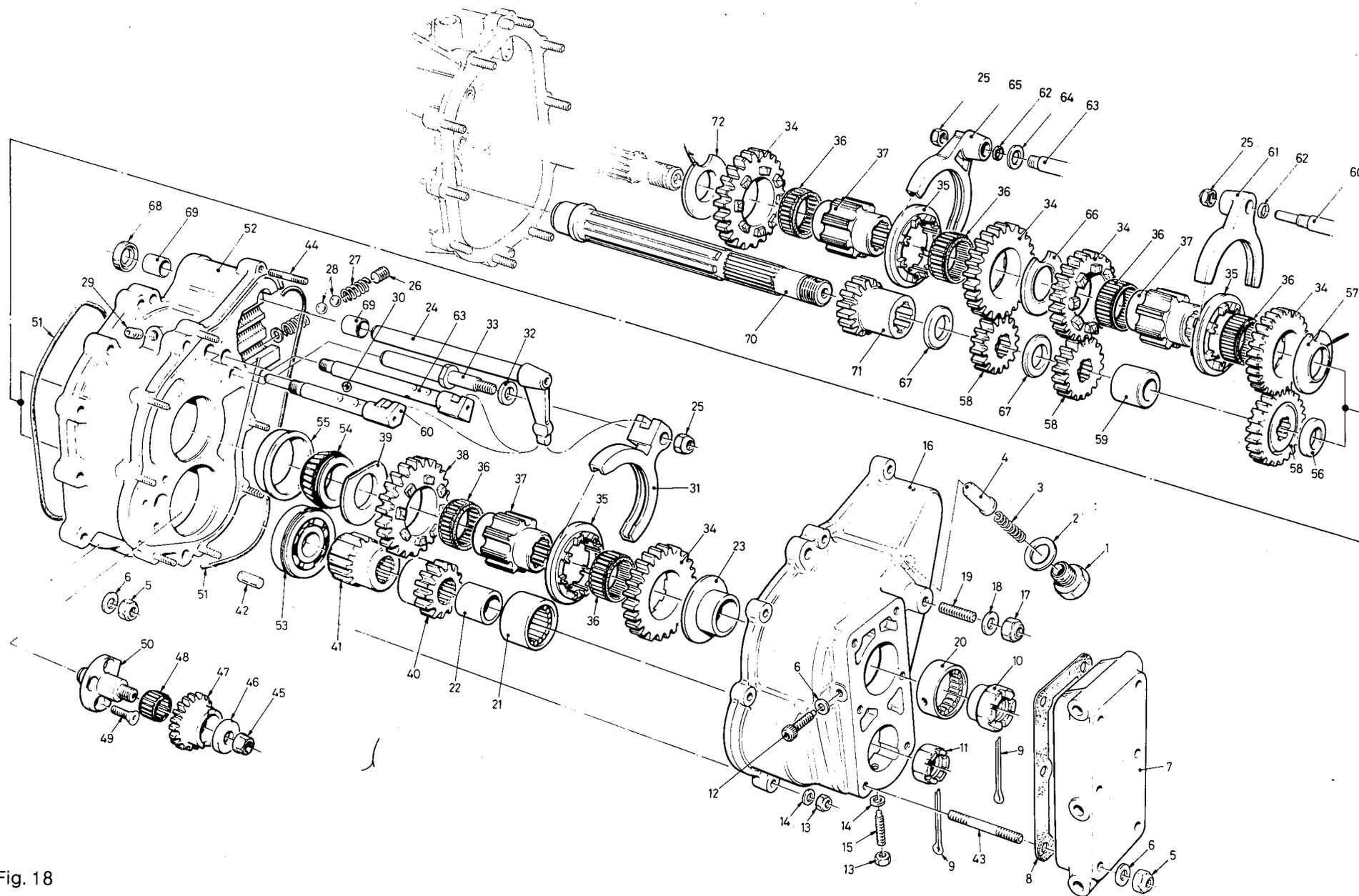
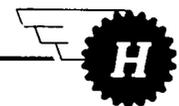


Fig. 18

## PARTS LIST - GEAR TRAIN ASSEMBLY 5 SPEED

Item No.	Description	Part No.	Qty.	Item No.	Description	Part No.	Qty.
1	Plug	FT 203 5	1	38	Pinion Shaft - Reverse Gear	LD 5 231	1
2	Dowty Washer 3/16in BSP	LD 203 7	1	39	Adjustment Spacer	LD 5 229 5	1
3	Spring - Reverse Plunger	HC 9 203 2	1	40	1st Gear - Layshaft	LD 5 235 1	1
4	Reverse Plunger	LD 203 0	1	41	Layshaft - Reverse Gear	LD 5 238	1
5	Nut M8 Nyloc	HC 201 3A	25	42	Dowel	LD 201 5	2
6	Washer 5/16in	FT 202 7	26	43	Stud - 2nd Bearing Carrier/Rear Cover	LD 201 3	6
7	Rear Cover	LD 5 204	1	44	Stud - Short	LD 202 5	8
8	Gasket - Rear Cover	LD 5 260	1	45	Nut - Reverse Idler	VG 237 5	1
9	Split Pin	FT 230 1	2	46	Washer - Reverse Idler	FT 237 4	1
10	Nut - Pinion Shaft	FT 230	1	47	Gear - Reverse Idler	LD 237 1	1
11	Nut - Layshaft	LD 5 236	1	48	Bearing - Reverse Idler	LD 237 2	1
12	Retaining Screw	LD 5 237 6	1	49	Screw - M8 Csk.	LD-237-8	3
13	Nut M6 Nyloc	LD 202 10	10	50	Spigot - Reverse Idler	LD 237 3	1
14	Washer M6	LD 202 9	10	51	Sealing Strip	VG 201 9	A/R
15	Retaining Screw	LD 5 234 3	1	52	1st Bearing Carrier	LD 5 202	1
16	2nd Bearing Carrier	LD 5 203	1	53	Bearing - Layshaft Middle	LD 234 3	1
17	Nut 3/16in Nyloc	LD 5 248 6	1	54	Bearing - Pinion Middle	LD 229 1B	1
18	Washer 3/16in	FT 258 5	1	55	Outer Track Pinion Middle Bearing	LD 229 1A	1
19	Stop Screw - 1st & Reverse	LD 5 248 5	1	56	Spacer - Layshaft Rear	LD 234 5	1
20	Bearing - Pinion Tail	HC8 229 1	1	57	Spacer - Pinion Middle	LD 229	1
21	Needle Bearing	F3A 234 1	1	58	Layshaft Gears	LD 235	3
22	Inner Track - Layshaft Tail Bearing	LD 5 234 4	1	59	Spacer - Layshaft 4th & 5th	LD 234 8	1
23	Inner Track - Pinion Tail Bearing	F3A 229	1	60	Selector Rod 4th & 5th	LD 5 247	1
24	Selector Finger	LD 252	1	61	Selector Fork 4th & 5th	LD 250	1
25	Nut Selector Rod	FT 246 2	3	62	Spacer Selector Rods	FT 246 3	2
26	Set Screw - Selector	FT 202 3	3	63	Selector Rod - 2nd & 3rd	LD 5 246	1
27	Spring - Selector	LD 202 2	6	64	Stop Spacer - 2nd & 3rd	FT 248 5	1
28	Ball - Selector	FT 202 1	6	65	Selector Fork - 2nd & 3rd	LD 249	1
29	Set Screw	FT 202 8	2	66	Hub Spacer	LD 5 229 4	1
30	Plunger - Selector Rods	FT 202 4	2	67	Spacer Layshaft - 2nd & 3rd/4th & 5th	LD 5 234 6	2
31	Selector Fork - 1st & Reverse	LD 5 251	1	68	Oil Seal - Selector Finger	FT 203 7S	1
32	Spacer - Selector Fork - 1st & Reverse	LD 5 248 4	1	69	Bush - Selector Finger	FT 203 6	2
33	Selector Rod - 1st & Reverse	LD 5 248	1	70	Layshaft	LD 5 234	1
34	Pinion Shaft Gears	LD 233	5	71	2nd Gear - Layshaft	LD 235 1	1
35	Clutch Ring	LD 232	3	72	Spacer - Front - Pinion Shaft	LD 5 226 3	1
36	Needle Bearing	LD 226 1	6				
37	Hub	LD 227	3				



# DIFFERENTIAL ASSEMBLY - 4 & 5 SPEED - SALISBURY TYPE FREE DIFFERENTIAL

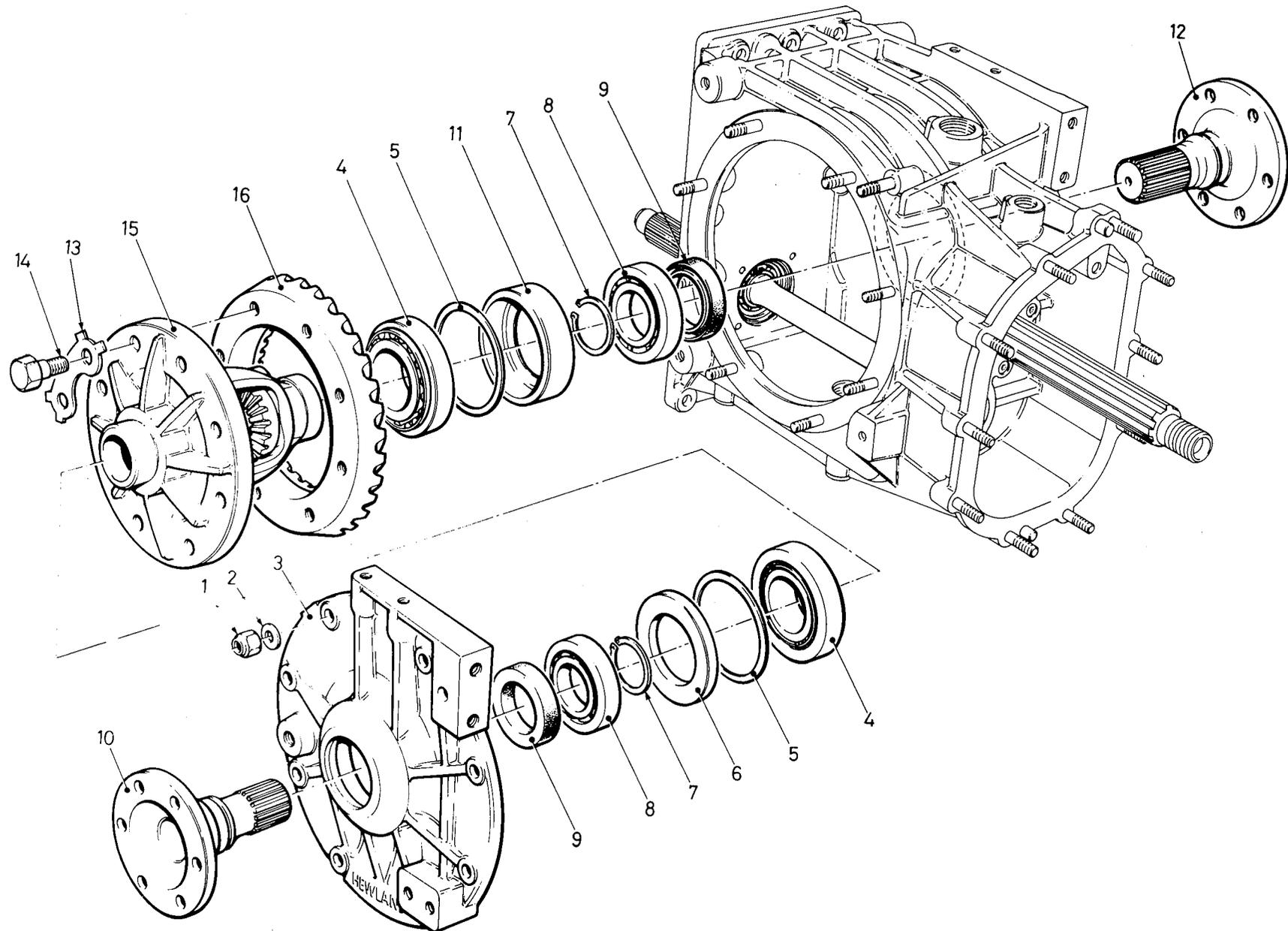
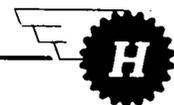


Fig. 19

## PARTS LIST - DIFFERENTIAL ASSEMBLY 4 & 5 SPEED - SALISBURY TYPE FREE DIFFERENTIAL

Item No.	Description	Part No.	Qty.
1	Nut M8 Nylock	HC 201 3A	9
2	Washer 5/16in.	FT 202 7	9
3	Sideplate	LD 205	1
4	Bearing - Diff Carrying	HC9 205 1	2
5	Shim - Sideplate	HC9 206 1	A/R
6	Spacer - Sideplate	LD 205 2	1
7	Circlip - Driveshaft	FT 219 1A	2
8	Bearing - Driveshaft	LD 205 3	2
9	Oil Seal - Driveshaft	LD 205 4	2
10	Driveshaft L/H	LD 218 L/H	1
11	Spacer - R/H Diff	LD 206 2	1
12	Driveshaft R/H	LD 218 R/H	1
13	Tab Washer	HC8 221 2	4
14	Crown Wheel Bolt	VG 221 1	8
15	Differential	HJC8-214-0R.	1
16	Crown Wheel	HC8 221...W	1 Sold as matched pairs only.



# DIFFERENTIAL ASSEMBLIES - POWERFLOW AND CAM & PAWL

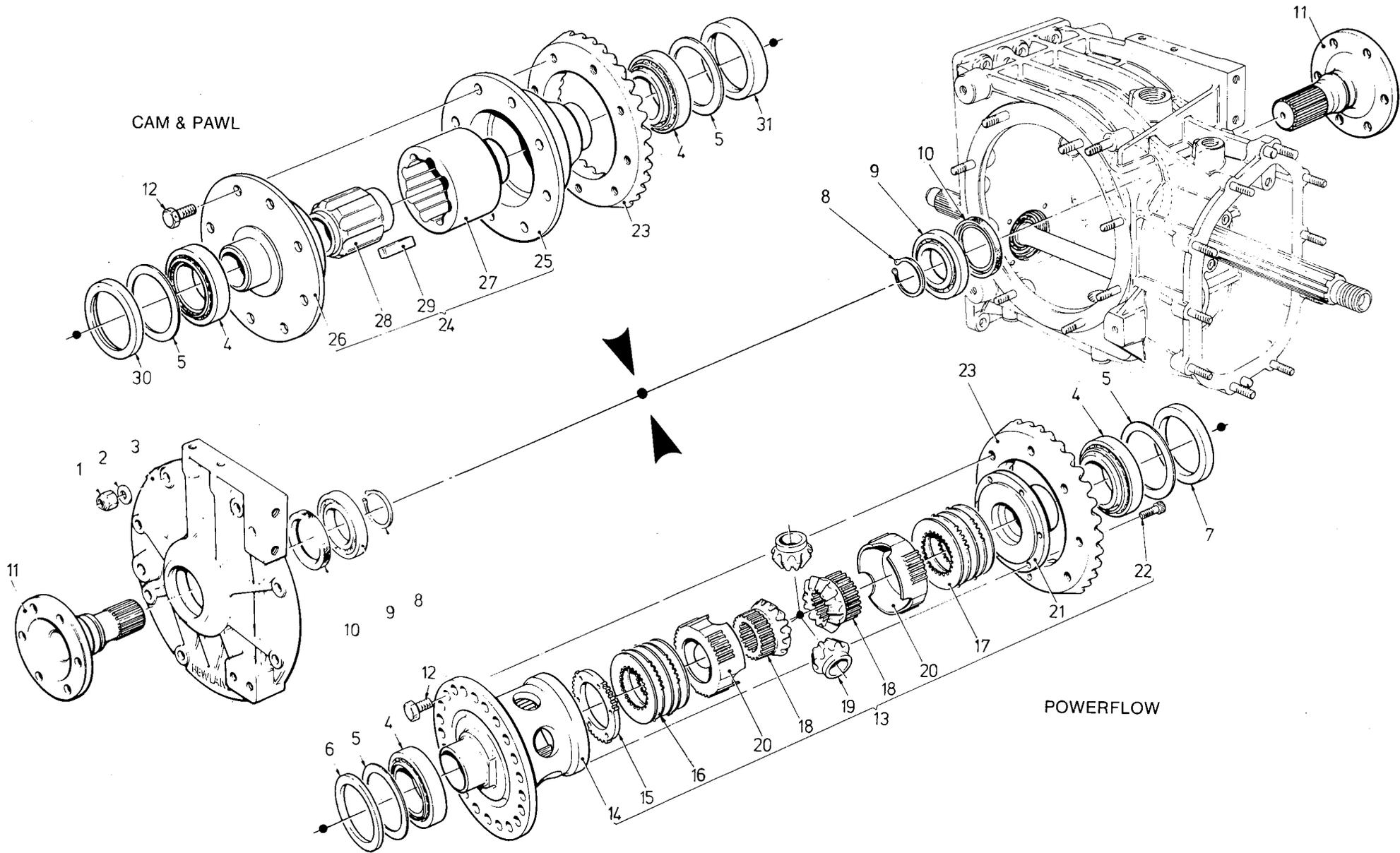


Fig. 20

## PARTS LIST - DIFFERENTIAL ASSEMBLIES - POWERFLOW AND CAM & PAWL

Item No.	Description	Part No.	Qty.
1	Nut M8 Nylock	HC 201 3A	9
2	Washer 5/16in	FT 202 7	9
3	Sideplate	LD 205	1
4	Bearing Diff Carrier	HC 9 205 1	2
5	Shim - Sideplate	HC 9 206 1	A/R
6	Spacer - Sideplate L.H.	LD 205 2A	1
7	Spacer - Sideplate R.H.	LD 206 2A	1
8	Circlip - Driveshaft	FT 219 1A	2
9	Bearing - Driveshaft	LD 205 3	2
10	Oil Seal - Driveshaft	LD 205 4	2
11	Driveshaft - For use with Powerflow Differential	LD 218	2
	Driveshaft - For use with Cam & Pawl Differential	LD 218 LH	1
		LD 218 RH	1
12	Bolt - Crown Wheel	VG 221 1	8
13	<b>**Differential Assembly - Powerflow -</b> Comprises items 14-22 inclusive	LD 212	1
14	Differential Case	LD 213	1
15	Spacer	FTC 213 3	1
16	Clutch Plate	FTC 213 10	4
17	Core Plate	FTC 213 8	6
18	Side Bevel Gear	HCC 213 6A	2
19	Planet Bevel Gear	FTC 213 5A	3
20	Ring - Side Gear	FTC 213 7	2
21	End Plate	HCC 214	1
22	Cap Screw	F3A 213 12	8
23	Crown Wheel	HC8 221...W	1
24	<b>**Alternative Differential Assembly - Cam &amp; Pawl</b> - Comprises items 25-29 inclusive	LD 212 CP	1
25	Differential Casing	LD 213 CP	1
26	Plunger Carrier	LD 214 CP	1
27	Outer Cam Track	HC 8 215M	1
28	Inner Cam Track	HC 8 216	1
29	Plunger	FT 217	8
30	Spacer Sideplate LH	LD 205 2	1
31	Spacer Sideplate RH	LD 206 2	1

**\*\*Alternative Differentials**

Items 6 & 7 are used with Power Flow (LD 212) and items 30 & 31 with Cam & Pawl Differential (LD 212 CP). The bearings, shims and oil seals are common to both differentials.



# MAINCASE ASSEMBLY - 4 & 5 SPEED

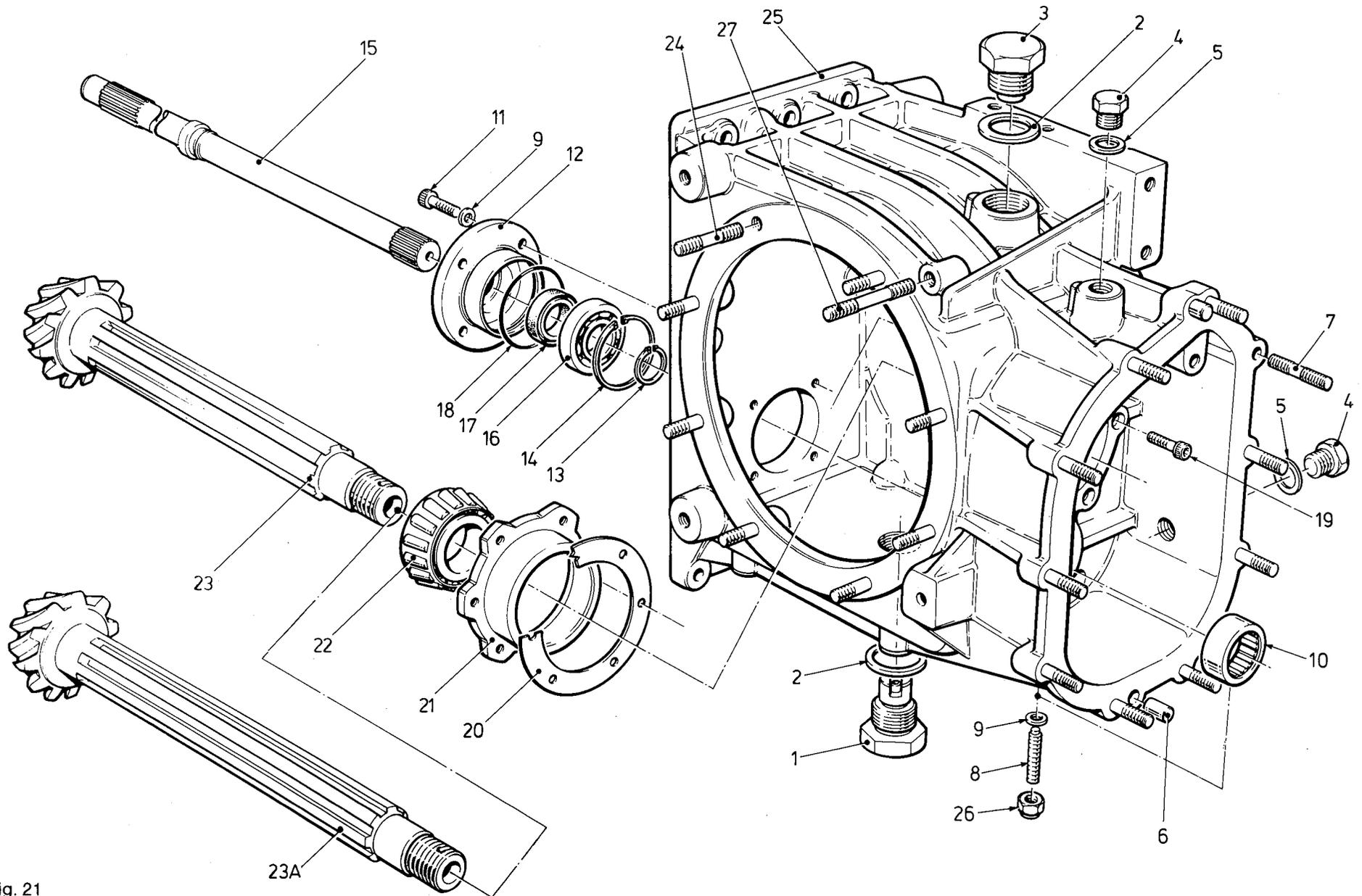


Fig. 21

## PARTS LIST - MAINCASE ASSEMBLY 4 & 5 SPEED

Item No.	Description	Part No.	Qty.	Item No.	Description	Part No.	Qty.
1	Drain Plug	VG 201 1	1	15	Clutch Shaft	LD 239...	1
2	Dowty Washer 3/4in. BSP	FGB 201 8	2	16	Bearing - Clutch Shaft	BEA-116	1
3	Plug 3/4in. BSP	VG 204 4	1	17	Oil Seal - Clutch Shaft	LD 244 11	1
4	Plug 3/4in. BSP	FT 203 5	2	18	'O' Ring	LD 244 13	1
5	Dowty Washer 3/4in. BSP	LD 203 7	2	19	Capscrew	LD 225 1	6
6	Dowel	LD 201 5	2	20	Shim - Pinion Head Bearing	LD 222 2	A/R
7	Stud - Maincase/Bearing Carrier	LD 201 4	10	21	Outer Bearing Track - Pinion Head	LD 223	1
8	Retaining Screw	LD 234 2	1	22	Bearing - Pinion Head	LD 223 A	1
9	Washer - M6	LD 202 9	5	23	Pinion Shaft - 4 speed	LD 221...P	} 1**
*10	Bearing - Layshaft - Front	F3A 234 1	1	23A	Pinion Shaft - 5 speed	LD 5 221...P	
11	Capscrew	F3A 244 13	4	24	Stud - Maincase/Sideplate	LD 201 2	8
12	Bearing Housing	LD 244	1	25	Maincase	LD 201	1
13	Circlip - Clutch Shaft	LD 239 0	1	26	Nut - M6 Nyloc	LD 202 10	1
14	Circlip - Bearing Housing	LD 244 10	1	27	Stud - Maincase	LD 201 3	1

\* On early 4-speed boxes this component was LD 234 1 which had an outside diameter of 37mm.

(If a cap head type of retaining screw was originally fitted, this should be replaced by items 8 and 26, as illustrated).

\*\*Sold as matched pairs only.



# GEAR RATIO CHART - FF1600 - 4 SPEED

Final drive ratio ... 9/31  
 Type diameter ..... 24.50 (Inches)

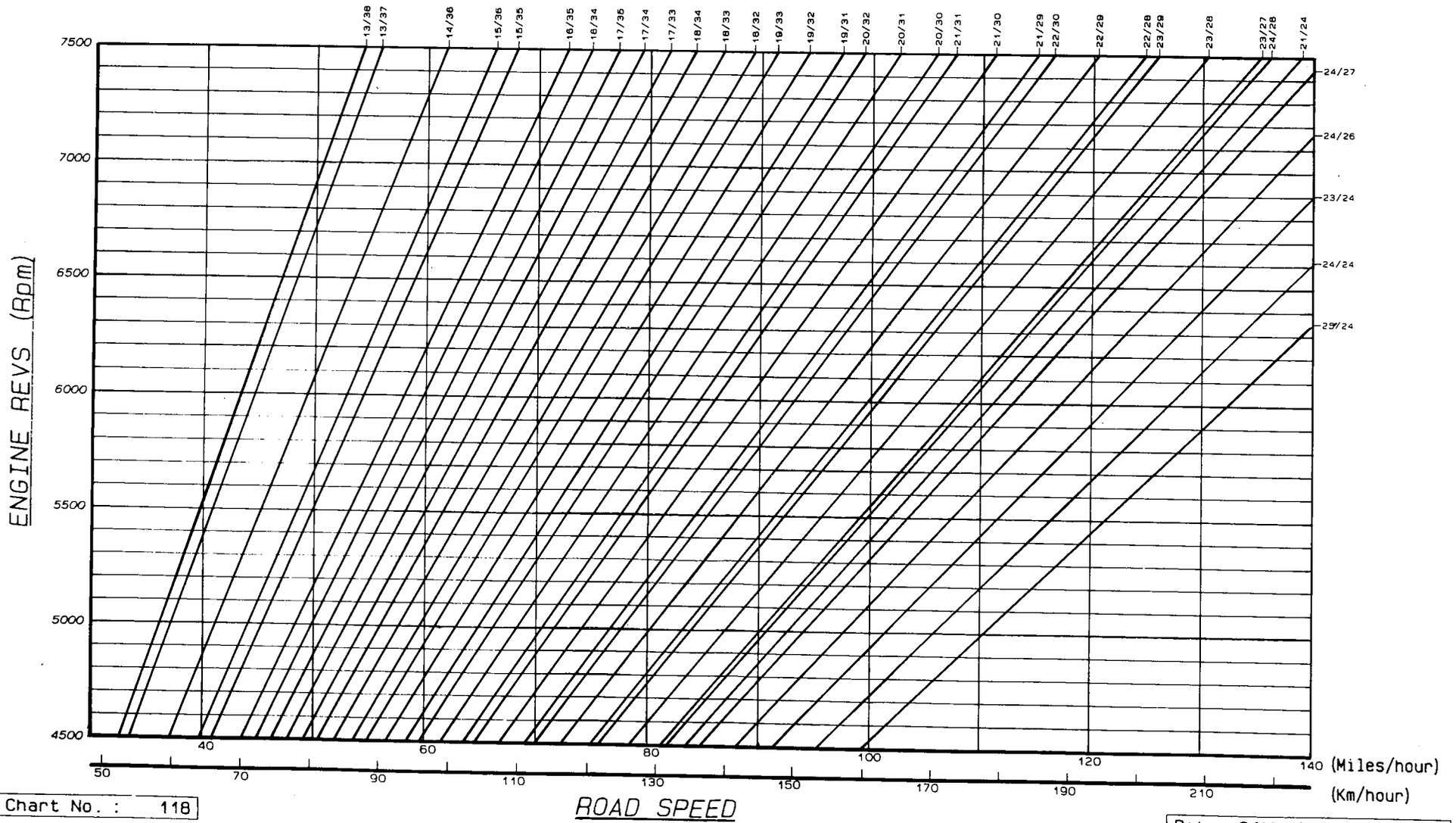


Chart No. : 118

Date : 24th January 1992

# GEAR RATIO CHART - FORMULA FORWARD

Final drive ratio ... 13/36  
 Tyre diameter ..... 22.30 (Inches)

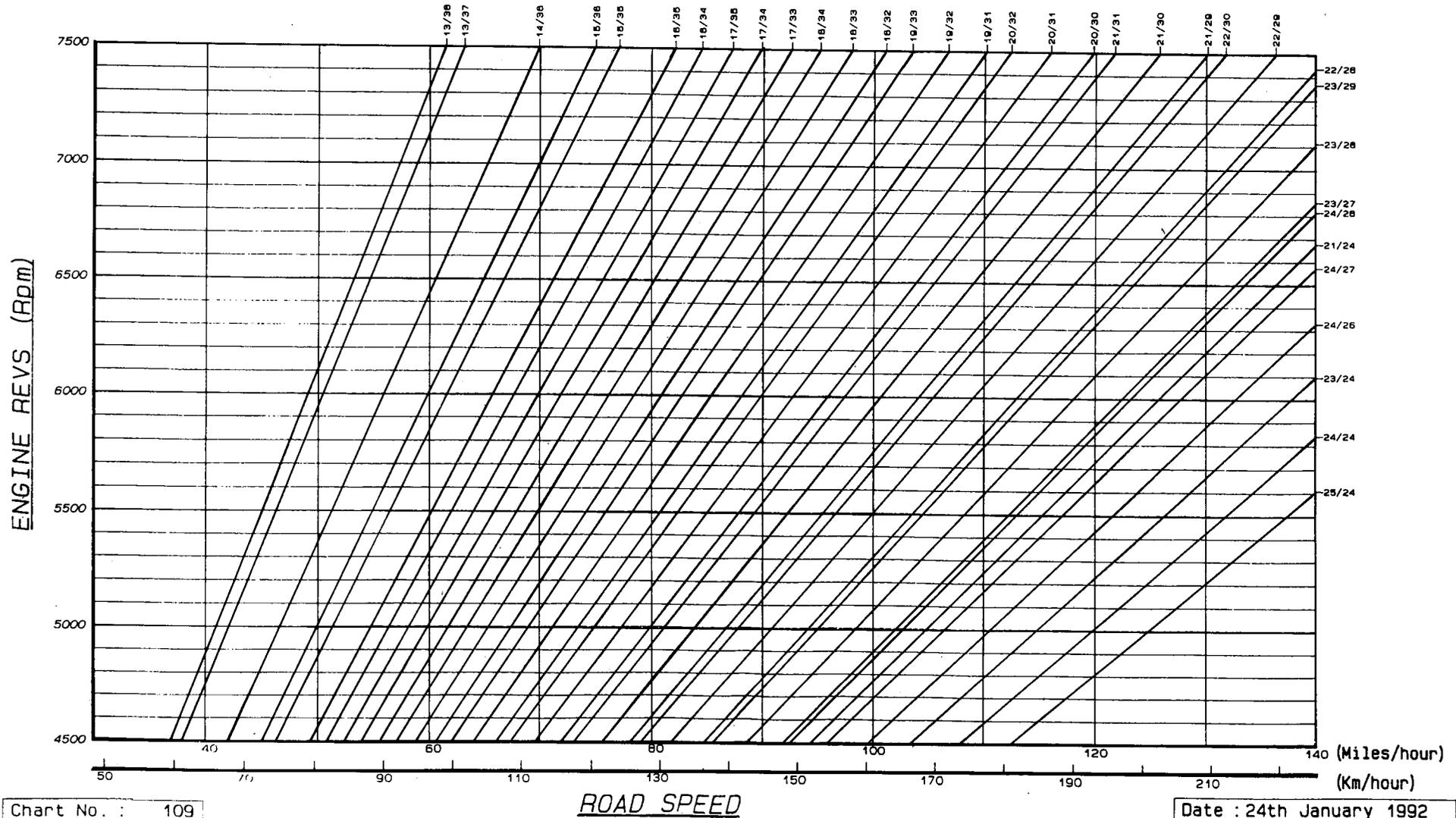


Chart No. : 109

Date : 24th January 1992

Fig. 23



# GEAR RATIO CHART - VAUXHALL JUNIOR

Final drive ratio ... 10/31  
 Tyre diameter ..... 22.00 (Inches)

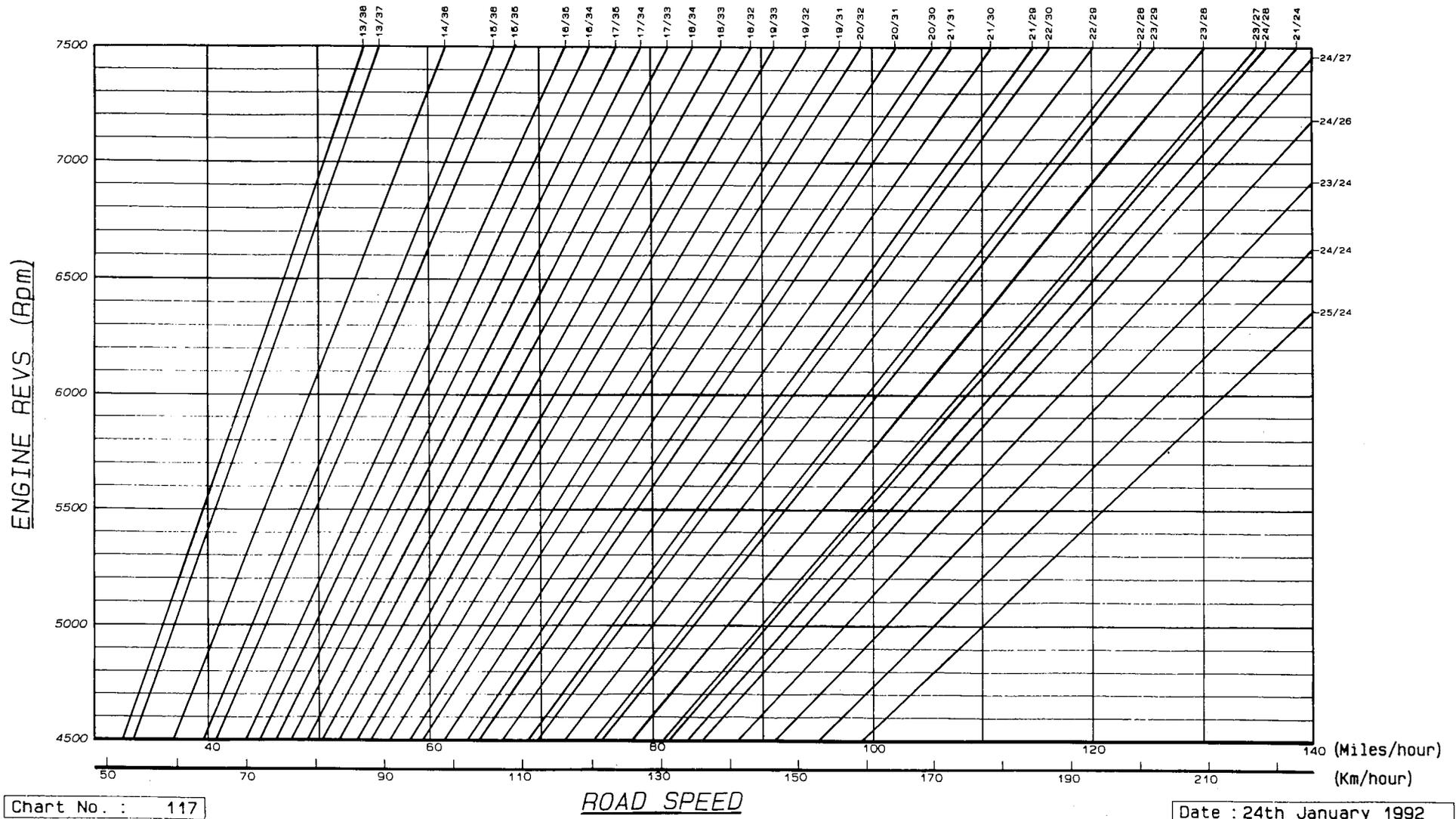


Chart No. : 117

Date : 24th January 1992

Fig. 24

## CHOOSING THE CORRECT GEAR RATIOS

Using the correct gear ratios is one of the key areas of setting up a racing car. It is far more important to understand for yourself the factors which determine the correct choice than it is to be told by someone else which ones to use.

Admittedly, the top teams will usually be using similar ratios but they will have arrived at their choices by decisions based upon *their* road speeds which is why a beginner may struggle if using the same set.

Firstly ensure that you have a current ratio chart in front of you, always available from ourselves by request and know the area of useful maximum power in your engine. (For example, it might be between 5,500 and 6,800 r.p.m.).

Then, 2 main considerations should be followed:

- 1) Ideally, when your final choice of ratios is made, the rev counter will never show outside of this range. (Realistically this is a bit optimistic but you should strive for it anyway). The r.p.m. should be noted on the exit of each corner at the point at which the throttle can be floored. If at this point the r.p.m. is not up to the lower end of the known power band (or higher) and the car cannot be driven faster, then using a lower ratio gear should be considered.

The procedure then is to examine the ratio chart to see which is the ratio to give the increased r.p.m. for the same road speed. i.e. find the line on the chart for the ratio that you are using and follow it to the r.p.m. that you were seeing at the corner in question. You then need to look upwards on the chart to find the point of the beginning of your power band and choose the nearest line/ratio available.

- 2) The second factor, the r.p.m. drops, should be considered in conjunction with the first and usually obtaining a compromise between the two is the hardest part. The point of this exercise, similarly to the first, is to see if the engine will be out of the power curve too much when simply driving up through gears on the flat out parts of the circuit or straights.

This is easy to check. Looking at the ratio chart, follow your 1st gear line up to the point of max. r.p.m.; the point at which you will change up. If you then drop a line straight down the graph until you hit the line of 2nd gear, you will quickly be able to see how many r.p.m. the engine will drop. Simply continue this process from gear to gear. The engine will pull large rev drops from 1st to 2nd more easily than from 4th to 5th for example, so the drops should get smaller as you go up, most importantly not dropping out of the power band in the highest two gears.

### OIL LEVELS

500 ml Sideplate bore

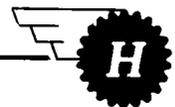
600 ml Crown wheel just touching

700 ml Layshaft front bearing cage

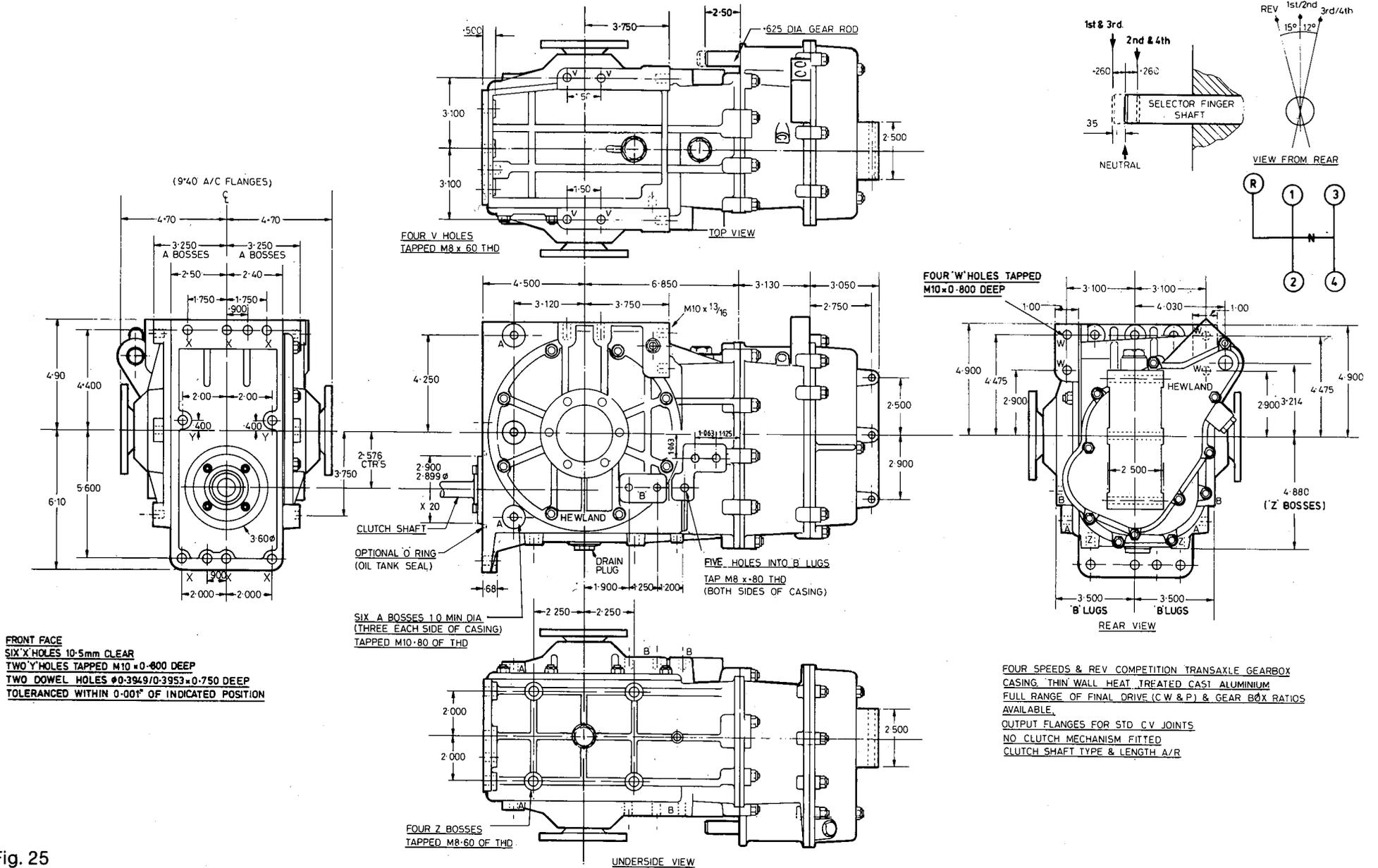
800 ml Touches inner track (layshaft)

1000 ml Touches spline on clutch shaft

Oil Level Plug 10mm above 1,000 litre



# INSTALLATION - 4 SPEED



FOUR SPEEDS & REV COMPETITION TRANSAXLE GEARBOX  
 CASING THIN WALL HEAT TREATED CAST ALUMINIUM  
 FULL RANGE OF FINAL DRIVE (C W & P) & GEAR BOX RATIOS  
 AVAILABLE  
 OUTPUT FLANGES FOR STD C V JOINTS  
 NO CLUTCH MECHANISM FITTED  
 CLUTCH SHAFT TYPE & LENGTH A/R

Fig. 25

# INSTALLATION - 5 SPEED

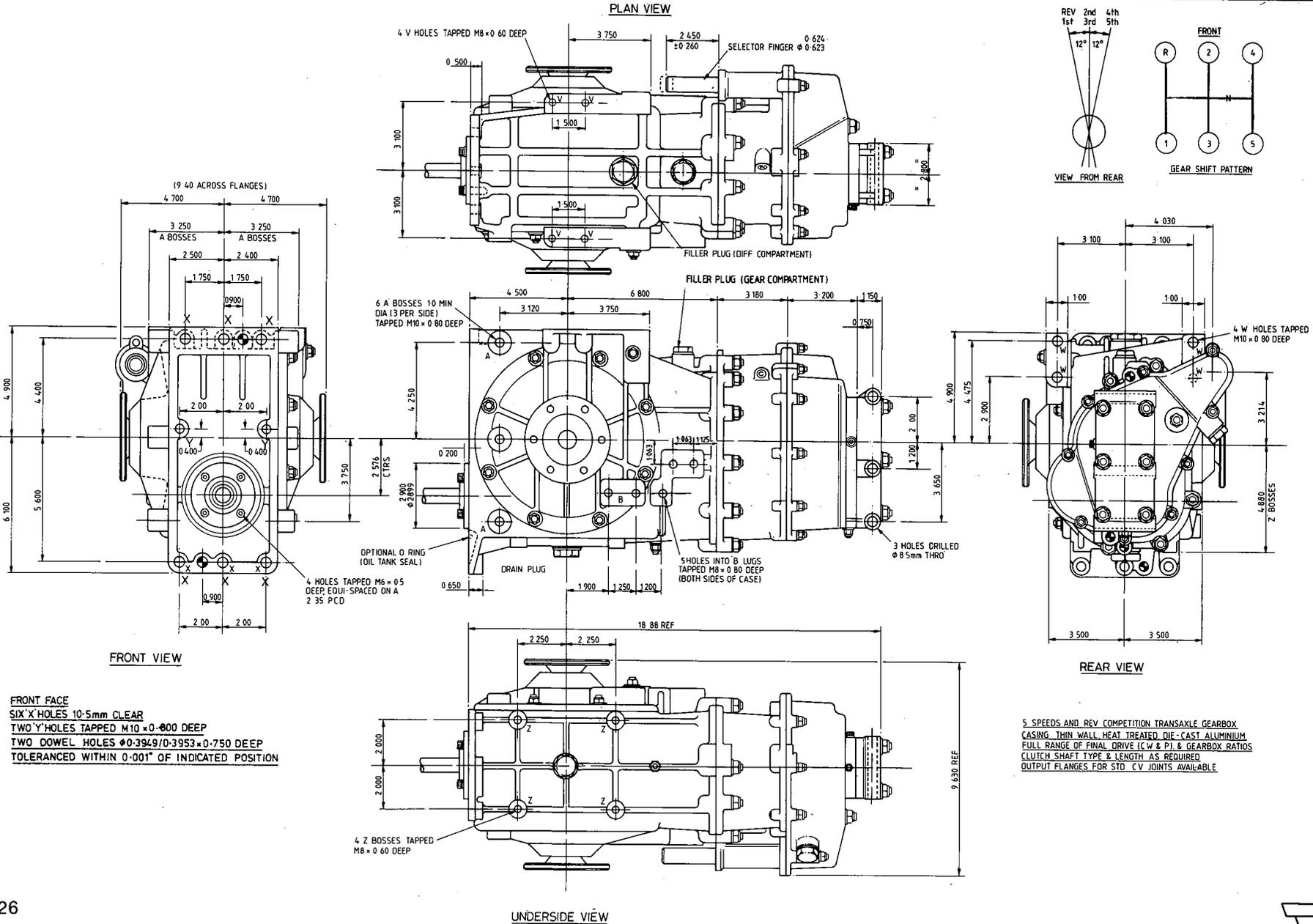
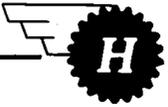


Fig. 26



# GEAR RATIOS

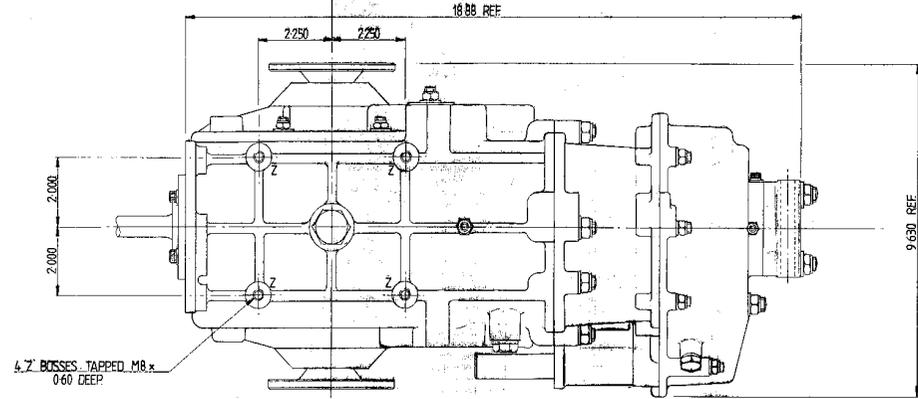
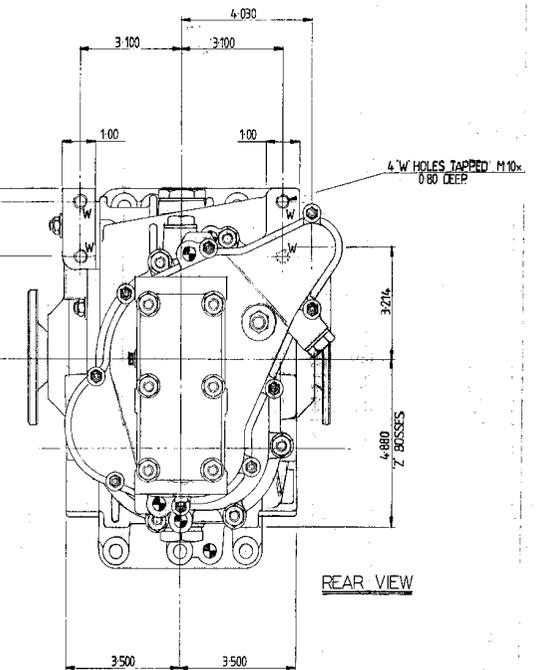
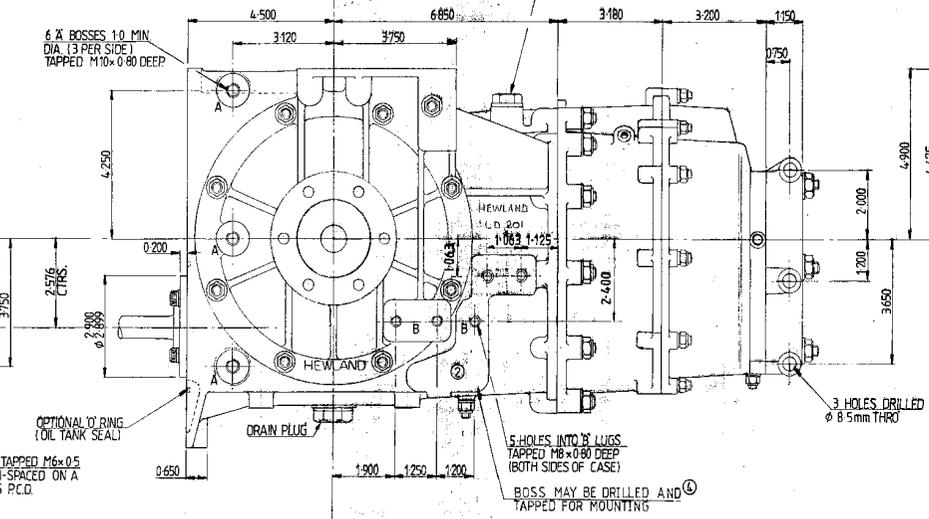
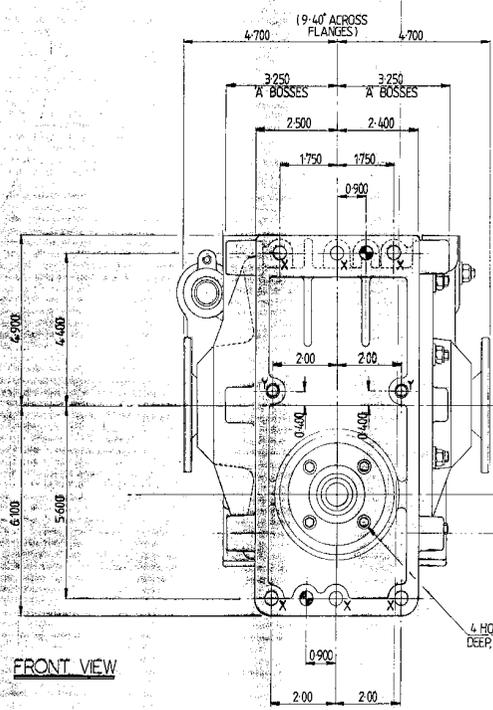
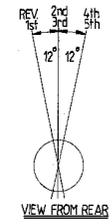
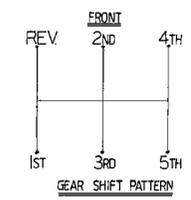
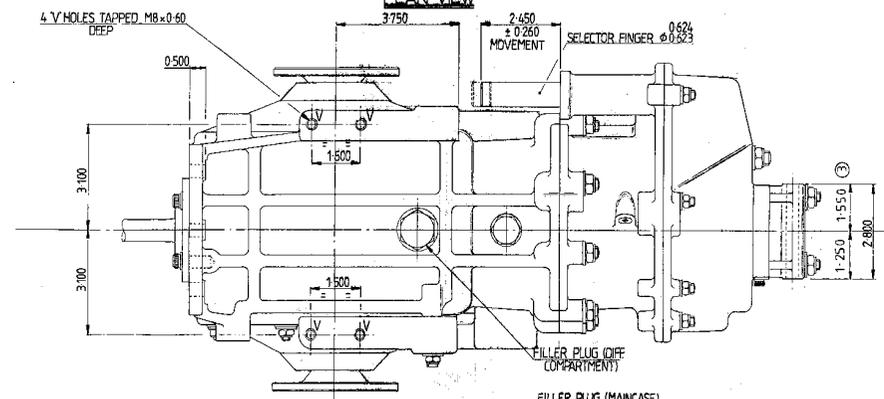
Circuit				Date			
	DRY	WET	QUAL		DRY	WET	QUAL
1st				1st			
2nd				2nd			
3rd				3rd			
4th				4th			
5th				5th			
Comments:				Comments:			

Circuit				Date			
	DRY	WET	QUAL		DRY	WET	QUAL
1st				1st			
2nd				2nd			
3rd				3rd			
4th				4th			
5th				5th			
Comments:				Comments:			



DO NOT SCALE. IF IN DOUBT ASK.  
REMOVE SHARP EDGES

PLAN VIEW



5 SPEEDS & REV. COMPETITION TRANSAXLE GEARBOX.  
CASING - THIN WALL, HEAT TREATED, DIE-CAST ALUMINIUM.  
FULL RANGE OF FINAL DRIVE (C.W. & P.), & GEARBOX RATIOS.  
CLUTCH SHAFT TYPE & LENGTH AS REQUIRED  
OUTPUT FLANGES FOR STD. C.V. JOINTS AVAILABLE.

FRONT FACE  
6 X HOLES DRILLED Ø 10.5mm THRO  
2 Y HOLES TAPPED M10 x 0.700 DEEP  
2 Ø WELLS Ø 0.3918 / 0.3953 x 0.750 DEEP  
TOLERANCED WITHIN 0.001 OF INDICATED POSITION.

DESIGNED BY	DATE
DRAWN BY	DATE
CHECKED BY	DATE
APPROVED BY	DATE
REVISION	DATE
1. WAS M10 x .800	ca 2/1/80
2. ERROR CORRECTED	2/1/80
3. ADDITIONAL CHANGE ADDED	2/1/80
4. MODIFICATION	DATE

SCALE 1:2	HEWLAND ENG. LTD.	DRAWN I.W.	DATE 25-5-90	ISSUED	NO./UNIT
DIMENSIONS INCHES	MAIDENHEAD.	TITLE LD-5-SPEED INSTALLATION DRG			
FINISH		TOLERANCES UNLESS SPECIFIED		DRG. No.	
H/T		METRIC ± .1mm ANGLES ± 1/2°		LD-5-200-1	
MATERIAL		FRACTIONS ± 1/16" POS. TOL. ± .002"			
MAT'L SIZE		DECIMALS ± .005"			
THIS DRAWING AND THE IMPLIED DESIGN HAS THE SOLE COPYRIGHT OF HEWLAND ENGINEERING LIMITED AND MAY NOT BE COPIED, WHOLLY OR IN PART, WITHOUT WRITTEN PERMISSION FROM THE ABOVE.					

## AMMENDMENTS PAGE

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DATE	DESCRIPTION
07/10/2010	Bearing LD-244-12 changed on page 35 for BEA-116, screw F3-237-8 on page 29 changed for LD-237-8